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THE INDUSTRIAL NORTH

IN THE LAST DECADE OF THE NINETEENTH CENTURY

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TALBOT BAINES

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A PREFACE BY

SIR HUGH BELL

AND

A MEMOIR

JOWETT & SOWRY LIMITED,
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TALBOT BAINES

THE publication of the articles printed in this volume engaged the attention of my father during the last year of his life ; permission was accorded by the proprietors of the *Times*, and Sir Hugh Bell, whose acquaintance with my father covered a long period, very kindly agreed to write the foreword that is also printed here. My father died while arrangements for the publication were still being made, and after careful consideration we of his family have decided to go forward with it as a tribute to his memory, though we recognise that the articles only represent a temporary phase of his work and are not in any way specially typical of his writing. At the same time we felt that the book would be incomplete without some form of biographical sketch, and in the preparation of this we have been very greatly helped by Bishop Talbot, who knew my father intimately from 1889 and has written his recollections of him for us; these we have incorporated with the memoir that follows, and we wish here to express our gratitude for his very valuable contribution.

My father, the grandson of Edward Baines and youngest son of Frederick Baines, and his wife, Susanna, daughter of John Reynolds, was born at Leeds in 1852 and educated at Rugby, where he had the rather exceptional distinction of being placed in the Upper fifth, and at St. John's College, Cambridge. Owing to ill-health, from which he entirely recovered, his time at Rugby was cut short by two years, which he never ceased to lament. At Cambridge he read Moral Science, in which he got a second. His time there was very happy and it had a considerable influence on the development of his character, so that he always remained a very enthusiastic and loyal supporter of his University ; and the friendships made there, particularly with Scott Allnutt, later Head of the Cambridge Mission to Delhi, lasted all his life and were in many cases renewed during his last years. On going down he joined the staff of the *Leeds Mercury* which had then been in the possession of our family for about 100 years ; the paper had at that time time a considerable position in the North of England as the mouth-piece of orthodox Whig opinion and he found himself in full agreement with its principles. In due course he succeeded to the chief editorship, but by the time this happened Gladstone had been converted to Home Rule, and here my father found himself unable to follow the Liberal party, and in complete disagreement with the other members of the family who were then working for the paper. His marriage to his first wife Margaret McCrone Greer, which took place in 1879, had a great influence on his political attitude. She was the daughter of Samuel McCurdy Greer, a leading Ulster politician, and my father's marriage strengthened the very strong connection that had been established by two previous marriages between the two families, including that of his first cousin and greatest friend Talbot Baines Reed to his wife's sister Elizabeth ; ever after this my father was a most devoted adherent of the Union and a supporter in particular of Ulster. His first wife died in 1886 at Maloja after a long illness during which he spent much time abroad with her. On his return to Leeds he went on with his work, and the continuance of the difficulties and disagreements caused by Home Rule led eventually to his resignation from the paper and to a very radical change in his career.

His action throughout this difficult time is very illustrative of his character. Though normally very willing to hear the other side of any case, his views on Home Rule and the position of Ulster were not really open to argument, and in support of them he showed that complete indifference to his own position and comfort, which, combined with the

utmost care of and thought for others, was one of his most marked characteristics. Leeds was his home, and work for the *Leeds Mercury* was the life which he had been brought up to expect and for which he had trained himself; accordingly for several years he continued to work for the paper by concentrating on foreign and in particular imperial affairs, leaving to others the purely political side. Mr. Riach, who was coeditor with him during this period has testified to the absolute loyalty to his colleagues with which he carried out his part of the work: but it was obvious that such a position could not last, and he finally severed his connection in 1897 and moved to London, thus giving up a life which he passionately loved and starting on a new life in unfamiliar surroundings with sublime courage, all from loyalty to deep set principles.

It would not be right however to pass on to his later life without dealing further with his work in Leeds, and in particular with his support of the campaign for Imperial Federation. The visit of Mr. (afterwards Sir George) Parkin kindled his interest in the subject and led to a very happy association and a life-long friendship in work that was very near to his heart. To quote Bishop Talbot " what is now a commonplace in various forms had then the freshness but also some of the difficulties of novelty. Baines saw at once all its importance, he responded with enthusiasm to the lead given by Lord Rosebery, and it came in very happily at a time of some embarrassment for him in political matters nearer home." There can be no doubt that the campaign had great effect and that it owed much of its effect to the undeviating support given by my father in the *Leeds Mercury* and outside it; this was perhaps one of the most fruitful bits of his work and remained a passionate enthusiasm with him all his life.

For the rest his life in Leeds was one of great activity; his work did not allow of his entering much into the municipal life of the town, but he was prominent in the more intellectual pursuits and was a very strong supporter of the musical festival. Many of his holidays were spent in the Lake district, where he always did a great deal of walking. The friendships formed there and in his life in Leeds were very strong and lasting, and it was all the more, in Bishop Talbot's words, " a fine sacrifice to principle " that he was prepared to cut himself off so entirely from all that they meant to him and " go out without knowing what was to follow and what path would open in front of him."

He had married, secondly, in 1891 Caroline Agnes Talbot, daughter of John Gilbert Talbot, Member of Parliament for Oxford University, and by this time had two children; two more were born subsequently. From 1897 to 1905 he lived first at Limpsfield and secondly at Ham, and worked for various papers in London. He was a leader-writer on the *Standard* and did a considerable amount of work for the *Spectator* and *Economist.* He was editor for several years of the *Annual Register*, and it was during this time that he wrote the articles for the *Times* that are now reprinted. The income from this work was however very uncertain and it became imperative that he should find more regular occupation; in 1905 the Secretaryship of the National Society for Church Education of the Poor fell vacant and he applied for and was appointed to the post.

My father had no previous experience of educational work but his interest in the subject was great, and, though brought up as a Congregationalist, he had from the time he was grown up attended the services of the Church of England and was confirmed at Leeds in 1893. The work necessitated daily attendance at the office in London, and he then moved to Haywards Heath in order to work up and down; he threw himself heart and soul into the cause of Church Education and worked with the utmost energy and zeal throughout a period full of controversy, devoting himself in particular to the editorship of the *School Guardian*, the official organ of the Society. Bishop Talbot writes of his work there: " Baines had the leading responsibility for policy under the direction of the Committee, with frequent reference to and guidance by the Archbishop of Canterbury; he had also a great deal of diplomatic work with the clerical and other representatives of Church Schools and with the Education Authorities; he brought to all this his characteristic qualities of unflagging industry and of marked and constant courtesy."

This work continued till 1916, when he was approaching the normal age for retirement. He then, by an act of self-effacement to which there can be few parallels, voluntarily proposed to the Standing Committee that Mr. Holland, the Assistant Secretary, should be appointed Secretary and that he himself should occupy the subordinate position of Assistant Secretary at a reduced salary; he also proposed to continue the editorship of the *School Guardian*, which he had raised from a position of very little note to one of considerable importance in the educational world. The arrangement was accepted, it being understood that the Society had not now a full claim on his time, and he then found further work in the Political Intelligence Department of the Foreign Office. This proved very congenial to him and in 1918 he finally resigned from the National Society and devoted his whole time to the Foreign Office. His work there was in many ways the most remarkable that he performed. He was then well over 60, he had not been abroad for several years, and he had never been particularly in touch with the currents of thought in France or the other countries with which he dealt; in spite of these handicaps he was able to produce articles and comments which earned great praise from Lord Curzon, then Foreign Secretary, and other high authorities at the Foreign Office; and an important official at the Sorbonne said of one of his articles that it so truly reproduced the French attitude that he could not believe it was written by a foreigner. All this is a striking proof of the depth and range of his mind, and it is probable that he enjoyed the work as much as any that he did; at the same time the strain was heavy, and partly in order to relieve him of the necessity of working up and down we moved to London in September 1920. Very shortly after this he received notice that the department was to be entirely closed down, and the anxiety caused by this and by my mother's serious illness, added to the general wear due to long years of overwork, brought on a paralytic stroke in November of the same year. Physically he made very little recovery from this, but his mind recovered much of its old alertness, and throughout the years that followed—he moved to Leeds to live with his sisters in March 1921—he retained the old journalistic instinct to comment on passing events as they occurred, and some of his articles were accepted for publication. He became however gradually weaker and died on November 29th, 1927, after a very brief illness.

Such in brief outline was my father's career and of him can it be said more than of most men that the career illustrated the man. His courage in leaving a settled and established position with the *Leeds Mercury* for no fixed occupation whatever; his self-sacrifice in continuing to work in a subordinate position at the National Society after having been Chief Secretary; his devotion to England, and his passionate belief in the justice of the British cause in the war, which led to his joining the Volunteer Training Corps at Hayward's Heath, when over 60, and attending his drills and camps with great regularity; in all these ways his character was revealed in his life, which showed an unfailing consistency in single-mindedness, in complete ignoring of self, and in absolute devotion to the right, whatever the cost and whatever the apparent worldly disadvantages. Bishop Talbot writes as follows: "..... one of his characteristic qualities was his extraordinary unselfishness; he was one of the most graciously unselfish men that I ever saw. The consequence was that the small claims of others, in family life or otherwise, were allowed oftener than was really right to clog his freedom and overtask his energies in detail." And of his last years "The remaining years of his life were marked by a beautiful patience, by a keen and unfailing alertness of observation and interest in matters public and private. He retained the old journalistic watchful observation of affairs and the desire to express himself upon them, and he could still write with some power. But it was pathetic for himself to feel and for others to notice that the old ability was physically hampered. When death came, quietly at last, it was the relief from the pathetic control of physical inability which was to the family who adored him the one mitigation of their loss. The loveableness and keenness of his character were most fully seen in his home—and this from his youth up: but he was one whose gracious qualities won upon all, a devoted citizen, a refined and cultivated gentleman and a true Christian."

For Father the word impossible had no meaning: he was ever undefeated, ever convinced that right must triumph however great the apparent success of wrong. His nature was many-sided; he was deeply religious and a most devoted adherent of the Church of England; he adored music, indeed all forms of art, and had a most delicate appreciation of the beauties of nature; he took a passionate and vivid interest in all human life, whether in politics or in literature or in any other form, and he felt the same absorbing interest in every individual life, with which he came in contact, and in particular in all that we his children did at school or in the world. He combined with perfect dignity and most beautiful manners a keen sense of humour and rejoiced in the most ridiculous family jokes and games: he was very fond of saying "come what may we have been blest" and by his great power of enjoyment as well as by his faith in the ultimate rightness of things he seemed to obtain more true satisfaction in life than many with greater achievements. So we who are left feel bereft of all that constant association with him has meant to us; but we are both stronger and richer for having before us in his life a perfect pattern and example of all that Christian manhood should be.

E.R.B.

PREFACE

SOME thirty years ago, Mr. Talbot Baines contributed to *The Times* newspaper a series of articles on "The Industrial North." He bears a name well-known in the journalism of that and the preceding eight decades, for he was one of the family to whom Yorkshire owed *The Leeds Mercury*, always a leading and stalwart expositor of fine progressive principles.

This Journal, which was in existence at the end of the 18th century, was brought by Edward, the grandfather of Talbot Baines, to the great position it subsequently acquired. Edward Baines was born at Preston in Lancashire in 1774. At 16 years of age he was apprenticed to a printer there. About the end of the century, and before his Indentures expired, he was transferred to Leeds. In 1801 he became the Proprietor of the *Leeds Mercury* which, at his death in 1848, had, for many years, ranked among the first provincial newspapers of the Kingdom.

He was succeeded in the newspaper enterprise by his second son, Edward, who, in November, 1858, received the well earned honour of a Knighthood and to whom, on his retirement from Parliament in 1874, Mr. Gladstone bore testimony for "the single-minded devotion, courage of purpose, perfect integrity and ability" he had shown in the discharge of his public duties.

This tradition Mr. Talbot Baines maintained for ten years as Editor of the *Leeds Mercury*, until 1897, when he resigned, owing to his dissent from the policy of the paper on the Home Rule question. He continued to take an active interest in public affairs and during the war served in the Political Intelligence Department of the Foreign Office.

The Times of 30 years ago was a leading organ of Liberal principles, not perhaps, very advanced, rather (one might say) Whig in character, averse from drastic changes in practice, but not unwilling to countenance improvement in social conditions, which, however, should not go beyond average public opinion. The leading articles with which on October 30th, 1896, Mr. Baines's communications are introduced and of April 30th, 1898, which concludes them, fully bear out this view.

The present volume is a reprint of these Articles. Mr. Baines has done me the honour of inviting me to say a few introductory words, a task which I have the more readily undertaken because I have an intimate acquaintance with the conditions as they existed 30 years ago, and have been familiar with some of the important industries of the North during the whole of the intervening period.

First, then, let us consider what was the industrial situation of Great Britain 30 years ago. The wonderful 19th century was drawing to its close; the Victorian era was nearing its end; we had already celebrated the Queen's Jubilee. The celebration of the 60th year of her reign occurred while Mr. Baines's articles were appearing in *The Times*.

The mid-century had witnessed the Great Exhibition of 1851, believed by the sanguine observers of the day to be a sign and forerunner of that universal peace among Nations, which was thought to be at hand. It is needless to dwell on the speedy disappointment of these hopes. Before that decade ended this country had been involved in the Crimean War and in the Indian Rebellion.

The following decade (1861-70) left us indeed in comparative peace (for the doors of the British Temple of Janus are rarely absolutely closed), but on the continent of Europe arose a struggle between Prussia and Austria which was the forerunner of even

greater catastrophes. The last year of that decade saw the second French Empire crumble and witnessed the beginning of political unrest in Europe, which was to culminate, more than 40 years later, in a struggle from the disastrous effects of which we are still suffering, so far without any certainty that our sufferings are ended. Mr. Baines's articles deal with the period rather more than a quarter of a century later than the year in which French Imperialism ended. The so-called Industrial Revolution, which may be said to date from the beginning of the century, was still in full swing, and politicians were being more and more impressed with the need of following up the Industrial Revolution with what we have since called " Projects of Social Reform."

It was in such circumstances that Mr. Baines undertook to give the readers of *The Times* some account of how matters stood in the Northern Counties of England. His survey comprises the four great industrial Counties of the North ; Northumberland and Durham, with their coalfields, and the industries which depend upon cheap fuel ; Lancashire and Yorkshire, chiefly noteworthy for their textile factories, but also for the production of the machinery for which these call and for their coal mines, which since then have become of ever growing importance. Nor must we omit the Iron Industry, which constitutes an important branch of the Industries of the County of York and specially of the North Riding. To this since 1850 the Ironstone of Cleveland has made the most important contribution. At the period dealt with by Mr. Baines it stood easily first in the Ironmaking districts of Great Britain. Nearly 40 per cent. of the Pig Iron output of Great Britain was made in the North-East of England, say, from Tees to Tyne. Cumberland comes within the survey in respect of deposits of Hematite Ore which give life to the great Works at Barrow and to other like establishments of less renown. If Westmoreland is not mentioned it is only because Mr. Baines did not think it necessary to his purpose to name the sources from which the teeming populations he dealt with drew their supplies of water. Had this subject come within the scope of his inquiry, Westmoreland and North Wales would have called for comment, for modern requirements have caused great aggregates of men to look far beyond their immediate neighbourhood for the supply of that essential adjuvant to modern sanitation.

The picture he draws is, on the whole, attractive and offers the prospect of still better conditions being within easy reach. The leading article with which *The Times* sums up the whole series, is pervaded by a tone of optimism, though a spirit of caution may also be noted. Things had greatly improved in the preceding twenty-five years. To quote from the Article :—

> " Any one who made such a survey a quarter of a century ago or earlier, could not truthfully be silent about traces of misery and discontent which he saw in Northern towns. He must have heard angry murmurs against all who were well-to-do and fierce threats by people who thought they must be wronged by a system under which they fared ill. He could not have missed seeing factories and workshops in which the letter of the Factory Acts might be observed, but in which there was scant attention to the health of the workpeople. He would have noted a certain hardness of relations between employers and employed, a tendency on the part of both to think their duties were confined to an observance of the letter of their contracts. Happily, matters are different now. From his journeys in Lancashire and Yorkshire our Correspondent brings back an encouraging and hopeful account. To take the vital question of houses. Most men are very much what their homes are, and the working men's house is, as a rule, much better than it was."

The writer of the Article proceeds to enlarge on the change the twenty-five years has effected and draws a hopeful picture as to what may be expected to follow. He makes some comments (not altogether favourable) on the " factory," which was, he says " in some ways a change for the worse " as compared with " the days of the old spinning wheel and the hand loom." But he too regards the situation with favour and the future with hope. He says :—

> " Our Correspondent brings back no tales of fierce antagonism on the part of the masses against the classes. There are no Nihilists in the industrial North and apparently few Socialists. The men whom he describes have no sympathy with anarchical economical schemes for nationalising this or that. But he does fear the growth, not, indeed, of class hostility, but of aloofness between sections of our population who have everything to gain from intimate knowledge of, and co-operation with, one another. We have not solved—we are still a long way from solving—the moral and economic problem of uniting the industrial efficiency of the grim-looking factory with all the virtues of the system which it drove out. Our Correspondent's account of the condition and outlook of most of our industries is hopeful. But there is need of prudence in all concerned if this is to be maintained. To take one of the greatest industries, coal-mining, he is doubtful whether over a considerable portion of the Northern mining districts any profits are being made ; and he is inclined to think that the passing of the Mines (Eight Hours) Bill ' would be likely to cause the rapid close of the less fortunate class of pits, with the result, not only of much local loss and distress, but of a sharp rise in coal prices, producing widespread industrial and general inconvenience.' "

It is true that in the period reviewed by Mr. Baines, there are not lacking signs of considerable industrial unrest. A noteworthy difference of opinion occurred in the Engineering industries, which resulted in an interruption of operations for 30 weeks ending in January, 1898. Two months later, in April of that year, the Welsh coal mines were laid idle and 100,000 men thrown out of work.

But in spite of these untoward and disconcerting symptoms, Mr. Baines is able to write with confidence as to the growing improvement in the relations between employers and employed. He contrasts the state of matters in Cleveland between 1862 and 1866, marked (as he says) by yearly strikes, and refers specially to a stoppage of 5 months in 1866 which he describes as " a mixture of strike and lock-out." The fact is that it is often very difficult to decide which of the two bad names shall be given to the Dog before we proceed to hang him. We have recently had a striking example in the Coal Trade when each side tried to throw the blame on to the other. Sir David Dale invented a term which permitted the event to be described in words which avoided the imputation of blame to either party—he called it " a cessation of labour."

The mention of his name brings us to a phase of the question which is much to the fore in Mr. Baines's articles. The absurdity, and in most cases the futility, of such occurrences had led to endeavours being made to find some method of settling differences between employers and employed without such " cessation of labour." Mr. Dale (as he then was) was much impressed by what had happened in the Hosiery Trade. In that industry, largely by the intervention of Mr. A. J. Mundella a voluntary tribunal had been set up to deal with questions of the sort. To quote from the Dictionary of National Biography Supplement, Vol. III. :—

> " In 1866, a time of much exasperation between employers and employed, he succeeded in forming the ' Nottingham Board of Conciliation in the Glove and Hosiery Trade,' for the termination and prevention of disputes by constant conference between representatives of each side. This was the first permanent and successful institution of the kind in this country."

Mr. Dale sought to introduce like methods into the Northern counties. His efforts were crowned with success and before long, in all the chief industries, such voluntary tribunals were established, for they were warmly supported by both sides. Mr. Baines names some of those who, as spokesmen for the workmen, bore their part in bringing about more harmonious relations. It would be easy to add to this list. The names of Burt and Fenwick in Northumberland, of Crawford and John Wilson in Durham may be instanced, and the list could be enlarged almost indefinitely.

These labours speedily produced organisations, which purported not only to settle any disputes which might arise, but also to determine how wages should vary with the varying trade conditions. From this to the establishment of a sliding scale which should connect the amount of wages with the sale price of the commodity was a short and easy step. The sliding scale did indeed provide a way of settling wages which satisfied the demands of the parties for some considerable time. But it is more than doubtful whether the connection between selling price and the share of the wage earner is sufficiently direct to make it possible to construct on it a formula, by which to determine from time to time what wages shall be paid in some particular industry.

This is certain, that after prolonged and patient trial, the method fell more or less into desuetude. It would take too long to consider in detail the causes of this failure, moreover the inquiry is foreign to the present purpose. In my opinion, it was due chiefly to the fallacious assumption that selling price determines wages. But it was also due to a further fallacy, still prevalent in dealing with wages questions, that some more or less arbitrary standard of life must be taken into account in deciding the amount of wages to be paid. But for nearly 30 years the Sliding Scale afforded the means of dealing with hosts of questions, which, without it, would, no doubt, have added considerably to the numbers of industrial disputes ending in the cessation of labour.

Let us now consider how far the hopeful views expressed by Mr. Baines have proved correct. Did the 15 years which followed the last of the articles, and which brought us to the eve of the war, bring us industrial peace? Must we not admit that in 1913 the outlook was by no means bright; "Labour" was making demands which "Capital" declared itself unable to meet. Those who had the clearest view of the situation were insisting that improvement in the conditions of labour must come from within; that the restrictive policy too often imposed on its members by the rules of the Union were hindering the advance they purported to encourage. It was not only in struggles between the men and their employers that this spirit was exhibited. Questions of what is called "Demarcation"—that is the boundary between one Union and another—led to "Strikes" in which the employers were mere helpless spectators of ruin to them and the whole of their men. It appeared impossible to convince the workmen that the only way to increase wages was to increase production.

The Golden Age hopefully foreshadowed by Mr. Baines had been heralded by numerous measures of "Social Reform." An ever renewed belief that legislation could contrive to get more than a pint out of the pint pot marked the 19th century as it had marked the 15th, when Jack Cade promised the mob on Blackheath that "the three hooped pot should have seven hoops." He was only an unconscious imitator of those who, thirteen hundred years earlier, thought to appease the discontent of the Roman populace by "*Panem et circenses*," which in to-day's parlance we may translate "Pensions and Pictures," or, perhaps, "Doles and Dog-races" might be still better. We had not yet got the promise of "ninepence for fourpence" nor had we been assured that a devastating war would produce a "land for heroes." These promises and many of like tenor were reserved for the present day. But the spirit underlying much of our legislation both when Mr. Baines wrote and since has not altered.

Specially, shortly before the war, measures were passed which were quite singularly ill conceived. I would mention particularly the Eight Hours Act which, after several earlier attempts, became law in 1908. It was the less justified because by means of the sort of organisation already mentioned, the coal miners in Northumberland and Durham had, by negotiation, obtained hours in many respects better than those which were enacted for the coal mining industry generally. In passing, let it be noted that the miners in these two counties resolutely refused to work the hours of the Act, preferring those they had obtained by negotiations. Before very long there arose among the miners an agitation against hard cases alleged to occur under the methods then in vogue for settling wages. This ended in 1912 in a general cessation of labour throughout the Country,

which lasted for some weeks. The Government intervened; many Conferences were held, in which members of the Cabinet took part; and ultimately in that year an Act was passed providing for a minimum wage.

The effect of these measures was foreseen by all those familiar with coal mining, or with industrial enterprise of any sort; it may be said by all acquainted with human nature. These persons affirmed that the measure would reduce the output of every man labouring in the coal mines. Not many months later the outbreak of war did, indeed, in Mr. Gladstone's pregnant and far seeing words, "banish economics to Saturn." We entered into an orgy of extravagance beyond the wildest imagination of the most irresponsible spendthrift. It seemed that the world possessed wealth which a stroke of the pen could evoke. "Credit" was "created" by the million pounds. Anything which the belligerents wanted must be forthcoming regardless of cost.

Some Cassandra-like voices were raised in warning. In four years thousands of millions of wealth were dissipated in an insensate struggle. Since then the economists have been vainly endeavouring to induce the world to believe in the imperative necessity of setting to work to recuperate the wealth thus destroyed; to persuade people that each man, speaking broadly, must live on what he earns; that you cannot, in the long run, rob Peter to pay Paul without doing irreparable injury to both.

But if Mr. Baines were doing for 1926-28 what he did for 1896-98, is it likely that *The Times*, summing up the result of the inquiry next year, would use the language quoted above without considerable modifications? Have Socialism and Nihilism (called, it may be, by different names) disappeared from our midst? The wholesome maxim, "If any will not work neither let him eat" is pooh-poohed and all kinds of means are adopted to undermine the thrift and self-help once held up to admiration. It would be an ostrich-like policy not to dwell on this aspect of affairs in considering the view Mr. Baines laid before his readers thirty years ago.

We must face the facts. The first thing the wise physician does is carefully to diagnose the disease before he suggests remedies whose remote effects may only exacerbate the evils they are meant to cure. Ancient wisdom is disregarded and old tried principles thrown to the wind. None will hearken to the teaching embodied in the following quotation from Herbert Spencer:—

> "Any arrangements which in a considerable degree prevent superiority from profiting by the rewards of superiority, or shield inferiority from the evils it entails—any arrangements which tend to make it as well to be inferior as to be superior; are arrangements diametrically opposed to the progress of organisation and the reaching of a higher life."

The qualities of thrift and foresight are weakened by their absence being rendered less disastrous.

It is useless to pretend that we live in an easy world. We are dependent on never-ending labour for existence. Our progress must come from our producing in each year more than we consume. The difficulty of the problem lies now, as it has ever lain, in deciding how the division of the product can be effected equitably. There are those who think that this can be done by some machine of their own construction, which they imagine would possess qualities enabling them to exact from each member of the community precisely his proper contribution to the general good and to accord to each his just share of the resulting product. These persons appear to less sanguine folk to hold two opposed opinions, for some say "To each according to his needs" and others, "To each according to his merits." There are, on the other side, those who think that individual effort, controlled as little as may be by the community as a whole, is the best solution.

The two opinions, in the extreme application of either are hopelessly opposed, but as each is insensibly modified by the facts of the world, they approach one another, till we

get to a borderland of compromise in which apparently will be found the only practicable solution of a problem of infinite difficulty. A sorry conclusion, it may be said, but one which has behind it high authorities reaching back into the far past. I have already quoted Herbert Spencer. Let me cite the use made of his views by Lord Morley in his essay on "Compromise":—

> "'It cannot be too emphatically asserted,' as has been said by one of the most influential of modern thinkers, 'that this policy of compromise, alike in institutions, in actions, and in beliefs, which especially characterises English life, is a policy essential to a society going through the transitions caused by continued growth and development. . . . . And yet, as for the carrying on of social life the old must continue so long as the new is not ready, this perpetual compromise is an indispensable accompaniment of a normal development.'"

Lord Morley himself goes on to say:—

> "Yet we must not press this argument, and the state of feeling that belongs to it, further than they may be fairly made to go. The danger in most natures lies on this side, for on this side our love of ease works, and our prejudices. The writer . . . . . is not professing to define its conditions or limits as a practical duty. Nor is there anything in his words, or in the doctrine of social evolution of which he is the most elaborate and systematic expounder, to favour that deliberate sacrifice of truth, either in search or in expression."

If an earlier authority were wanted, I might cite Burke, who, dealing with a very similar subject in 1775, in his speech on his resolutions for conciliation with the Colonies, says:—

> "All government, indeed every human benefit and enjoyment, every virtue, and every prudent act, is founded on compromise and barter. We balance inconveniences; we give and take; we remit some rights, that we may enjoy others; and we choose rather to be happy citizens, than subtle disputants."

But have not all wise men always held the same view? Twenty-three centuries before Burke urged conciliation on his contemporaries, a Greek moralist said:—"Conciliation indeed is profitable, but strife produces strife." No better motto could be taken for our guidance to-day.

HUGH BELL,

August, 1927.

POSTSCRIPT.

Since the above was written we have had to deplore the death of Mr. Talbot Baines. I have not attempted to modify what I have said to meet the altered circumstances, but I should like to express my deep sympathy with his widow and family in their bereavement.

H.B.—*April*, 1928.

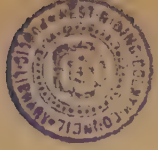
AUTHOR'S PREFACE

THE articles contained in the following pages are the result of some two years spent in the Nineties of last century in investigations into industrial conditions in the West Riding of Yorkshire, Durham and Lancashire. These included visits to coal mines and the great engineering works, which embraced those devoted to the construction of iron and steel ships and machinery for use in textile mills—woollen and cotton. In all cases I should like to say that my enquiries included conversations with the chief owners and the leading workmen of the works concerned.

I wish to express my great obligation to the Proprietors and Editor of *The Times* for their permission, very graciously given, to republish the articles of which this book consists.

I have been indeed fortunate to secure a Preface from Sir Hugh Bell, who gave me much help in the preparation of the articles.

TALBOT BAINES.



THE INDUSTRIAL NORTH IN THE LAST DECADE OF THE NINETEENTH CENTURY

The Times, Friday, October 30th, 1896.

THE first of a series of articles which we publish to-day draws attention in detail to a contrast which every one has noticed, and no one, so far, has adequately studied—a contrast between North and South, between industrial, political, and social England north of the Trent and south of it, between the changes in operation on either side of that line. Centuries have not wholly effaced the local differences; some of these seem to become more pronounced than they were. The railway and the telegraph are the shuttles which, swiftly shooting to and fro, weave into one fabric the national life; but the warp and woof not being all of one stuff, the texture and pattern remain very diverse. It is astonishing how much is found on a close, careful inspection, such as our Correspondent has made, to have escaped the levelling influences of time and common institutions. When CAMDEN in his "Britannia" passes from one county to another he writes as if he had entered a totally new country; and were a modern Camden to make a journey through those parts of England which our Correspondent has in view there would be found local peculiarities almost as marked as those which struck the Elizabethan topographer. Occasionally an artist, such as MRS. GASKELL in her well-known novel, makes a point of the contrast between North and South; but we hear most of it when a political question stirs more or less the whole country. Then, in speeches and political literature much is said of the difference between the Northern and Southern types of character, the comparison being generally, it must be owned, made to the advantage of the former. The superior robustness and wealth of rugged virtues in the Northern counties and the aptitude of the dwellers in Lincolnshire or Yorkshire villages for appreciating discussion of general principles, to the exclusion of merely parochial or personal questions, are insisted upon. It, perhaps, benefits—it must at least chasten—the Southerner to hear what is said of him by the organs or representatives of public opinion in Northern cities. North of the Trent, it is often suggested, are found most of the back-bone and manly virtues of the country; south of that line exists what amount of good is consistent with somewhat invertebrate moral structures. MRS. GASKELL makes one of her characters, who moves to a Northern town, note that things were more "purpose-like" than in the South, that the country carts had more iron in their composition and that the horse-gear was stronger. More than one Bishop or incumbent, drafted to Southern regions, has been known to speak of his new neighbours in terms of compassionate condescension as if he had to deal with altogether weaker and frailer natures than those to which he has been accustomed.

Some of the differences are described in our Correspondent's first communication, which appears to-day; and one of the chief of these is the existence in Northern parts to a degree elsewhere unknown of "the element of local corporate unity." In its most pronounced form it is found in some great towns in Yorkshire, Lancashire, and the neighbouring counties; and its presence begets a public spirit fruitful in all manner of good civic deeds, a wholesome rivalry between communities, and a healthy local pride, without which modern England would be much poorer than it is. This element is also to be found in Northern villages and dales. Let the occasion be a national jubilee or a stirring political controversy, and even small rural communities will insist upon showing

their opinions and their enthusiasm in their own way, and will prove, as our Correspondent remarks, that events affecting the reputation or the welfare of the inhabitants of their town or village "move them in a very genuine fashion." This circumstance no doubt "gives an element of interest and, so to say, of warmth to life in the manufacturing districts of the North of England which to a large extent is wanting in the South of England and in London, though it is true that in the East-end local patriotism has been developed in considerable vigour." It will scarcely be questioned that our Correspondent points to a real phase of the life of people of Northern districts in the remark that "they have much of the carriage and temper of a race of freeholders," even where leasehold tenure is, and always has been, prevalent. The spirit in these parts is rougher and more direct, there is more "snap" and point in popular parlance, and the demeanour to a newcomer is less openly friendly and more aggressive. What our Correspondent describes as the "freeholding temper" is apt to veil real courtesy and natural politeness under stiffness of manners and homely plainness of speech. About another characteristic adverted to by our Correspondent there is likely to be more controversy. There are in the Northern counties plenty of beautiful villages. It would be rash to assume that in the portfolios or sketch-books of artists who have roamed over England in search of subjects more would be found to be taken from scenes south of "princely Trent" than north of it. But many familiar facts go far to justify our Correspondent's remark that in the Northern industrial districts there is an "almost absolute content with the positively ugly." Griminess for griminess' sake, a toleration of smoke and gloom, a readiness to accept ugliness with all its consequences, seem to characterize many "frankly hideous" mining and manufacturing villages. Often the houses begin and end in and are surrounded by things squalid and unkempt, abysmal sloughs of despond, and sorry mixture of the odds and ends and refuse of both rural and urban life. And, strange circumstance, this acceptance of what is repulsive to the eye, if not to other organs, is perfectly compatible with scrupulous cleanliness in the house. Inside, a clever housewife, proud to do her humble duties, has made every brass or copper utensil in the little cottage sparkle; dust is unknown, and the floor is speckless, while outside is a howling wilderness of cinder heaps, the very gardens having sometimes a sunless, flowerless, and untidy look. It is just possible that a visit to southern villages, with their ancient, spontaneous beauty of circumstances, would open the eyes of the dwellers in some of the villages of which our Correspondent writes. Possibly, too, such a visit would correct other misconceptions and enable people who are struck by the slow, lumbering speech of southern labourers to understand that their taciturnity is often a mask to hide a tenacious memory and a keenly critical view of strangers. Close examination will reveal many other differences still surviving—differences not merely in dialect, but in modes of thought and turns of expression; differences in manners; and last, but perhaps chief in importance, differences in favourite amusements. Football is now popular everywhere, but for the northern workman a horse race has probably greater attraction than it has for the southern. On the other hand, as is pointed out by our Correspondent, the northern working men, though well paid, "are very much less provided with evening amusements than the same classes in London."

The oldest eulogies of this island never fail to mention the happy combination it presents of diverse qualities of climate and soil. DRAYTON speaks of it as that land where "heat kills not the cold, nor cold expels the heat; The calms too mildly calm, the winds too might great; Nor night doth hinder day, nor day the night doth wrong; The summer not too short, the winter not too long." Perhaps at first blush it might seem that it would have been better had the extremes of character which our Correspondent portrays been unknown, or been fused by civilization into one uniform kind, and the praises bestowed, more or less justly, upon the moderation of climate been equally due to English types of character. But on second thoughts it will be recognized that England is richer and stronger by reason of the diversities which School Boards and centuries of civilization have not obliterated between North and South and which seem likely long to survive.

I.

A FEW GENERAL CONSIDERATIONS

FOR the lifetime of a generation it has been possible to travel in five hours or less from London to the heart of the great industrial districts of Yorkshire and Lancashire. Of late years the comfort with which that journey can be made by third-class travellers has been immensely increased, and the intercourse constantly going on between the principal centres of Northern and Southern life has been correspondingly developed. Yet there is much ground for believing that observant or sensitive travellers in both directions are still conscious that between the morning and the midday or the midday and the evening meal something is changed besides the quality of the air and the character of the scenery. Nor is this consciousness of difference merely transitory. There are natives of the South of England, persons of wide culture and sympathies, who will tell you that a visit to the North is to them always the same kind of experience as that of a visit to a foreign country. More than that, there are natives of the South, who have lived and worked for long years in the North, who will confess that they have never quite lost the feeling of expatriation. Such persons would indeed probably acknowledge that if circumstances had required them to settle under any other flag than the British, they would have felt, whenever any Northern Englishman crossed their path, that the differences in speech, in manners, in temperament, in modes of thought, and ways of looking at things, by which he might be distinguished from the average type of the dwellers around their own old homes in Southern England appeared trifling and insignificant compared with the broad characteristics by which they recognized him as a fellow countryman. But, even so, many of them still feel that, collectively, the points of contrast to be met with in the North of England produce an atmosphere as really, if not as profoundly, distinct from that of their own native districts as is the atmosphere of one of the Continental nations. It may be contended that the existence of these diversities of type within the borders, not only of Great Britain, but of England, is a source of national strength. That is probably very true, and the possibility that the various educational and other influences now at work in the direction of uniformity may have their perfect work in the disappearance of the points of contrast between the natives of some of the leading divisions of the island is by no means full of attraction. At present, however, that consummation seems fairly remote, and the differences in question, though not perhaps very easy to define or to analyze, are in their combined operation sufficient to produce from time to time a want of clear mutual understanding.

An interesting example of the want of perfect *rapport* between North and South in England, even where such *rapport* might naturally have been with some confidence expected, arose in connexion with the Government Education Bill of last Session. No single cause, of course, can be assigned for the failure of that unfortunate measure, but undoubtedly one of the chief of them was the difference which arose within the Church of England on the question whether additional public assistance to voluntary schools ought to come from the national Treasury or from local rates. It is not at all necessary to enter here into the merits of that controversy. The point which now concerns us is that, if there had been a clearer understanding between North and South, the protest raised by Lancashire as to the practical necessity of rate aid to the continued existence of its voluntary schools would not have been made as and when it was made. The strength of Lancashire feeling on the subject, that is to say, and the peculiar local conditions on which it rested would have been taken into account by the leaders of Church opinion many months before, and either accepted as a rightly determining factor in the legislative problem, or definitely pronounced to be of insufficient importance. Such would certainly have been

the case if, for any reason, Hampshire or Devonshire had been the county entertaining special views as to the manner in which the resources of voluntary schools should be aided from the public purse. But as the county concerned, though far more populous and important than either of those just mentioned, was away in the North, the necessity of considering and deliberately dealing with its attitude was only realised with a tardiness that contributed very appreciably to the legislative *fiasco* which occurred. This is not to say that any particular persons were to blame for the failure to understand the Lancashire position. Lancashire Churchmen themselves may have failed to explain quite clearly the special features of their case. But the fact remains that it was not until some time after the withdrawal of the Government Bill that the late Archbishop of Canterbury and the Bishop of London were led by a very simple statement of facts and figures by the Archdeacon of Manchester to recognize that, at any rate, the position taken by Lancashire Churchmen on the schools question could not fairly be attributed, as had been widely supposed, to the prevalence of a habit on their part of making smaller sacrifices for religious education than Churchmen in other parts of the country.

We may be sure that, if a misunderstanding of this kind can occur among those of the same religious communion at a period when it is of great importance to them all to be acting in mutual harmony, misapprehensions not less considerable, arising from a similar want of knowledge, must be of frequent occurrence in other departments of national life. And as misapprehensions arising from want of knowledge can never be advantageous in a nation any more than in a family, there is much to be said for a little more effort than most of us are in the habit of making to grasp the points in which Englishmen born in the North and in the South of England are apt to differ from one another, and the conditions of life by which those differences are maintained and possibly accentuated. In succeeding articles the present writer hopes to be able to make some contribution towards a realization by dwellers in the Southern counties of the present character, position, and prospects of the great industries which furnish the occupation and the means of livelihood of by far the greater part of the population of the Northern counties. To help, in whatever measure, to a comprehension of the manner and the circumstances of people's lives is to help, in a like measure, to a comprehension of those people themselves. That method of approaching the subject is, indeed, better calculated to be of real service than any attempt to catalogue what may be supposed to be the principal elements of contrast between the dwellers in the parts of our common country under consideration. It is so easy to generalize from a limited range of observation and so certain that such generalizations must be charged with error. Yet the impressions prevalent among those who have had good opportunities of comparing the inhabitants of Northern and Southern counties must go for something; and a few remarks as to those impressions may fairly be made at this point. Whatever is said on the matter must be taken to apply primarily and almost entirely to the middle and working classes. Such differences in type as may have existed between the upper ranks of society in North and South have not survived in any appreciable form the fusing influences of public school and University education. Another reservation to be made is as to the districts between which comparison may be fairly drawn. It is not fair, for example, to compare London with the dales of North Yorkshire; or Manchester, Leeds, or Newcastle-on-Tyne with Kent or Sussex. To compare country folk with country folk, urban artisan with urban artisan, would seem the fair thing to do, but it must be remembered that over very extensive districts in Lancashire, Yorkshire, Durham, and Northumberland life has long ceased to be, in the ordinary sense of the word, rural without becoming strictly urban. The bulk of the inhabitants in those districts is engaged either in mills or in mines, but they are not crowded together in towns. There are great stretches of country, more or less disfigured no doubt, but still open, around their homes.

When you get at the really rural districts of the North you are conscious of less difference between their inhabitants and those of rural districts in the South than you have noticed between the latter and the dwellers in or near the manufacturing or mining

villages of the North. Yet there is a difference. The country folk of the North are on the whole more self-contained, more independent in character and bearing than those of the South. Though the freehold tenure of land is not and perhaps never was, except in certain limited districts, extensively diffused among them, they have much of the carriage and temper of a race of freeholders. You will meet with as much real courtesy, but not always with as many of the forms of deference usual in the South to those of superior station. In this respect, indeed, there is variety within the North, but the style of speech tends to be more familiar and less deferential, and that tendency is strengthened where the surroundings cease to be purely agricultural. Hardly anywhere in the South would a farmer be heard not only refusing point blank to listen to a proposal of his landlord's to alter a farm building but also rejoining, when the squire gently observed that after all the building was his own, " Nay, my forefather went to the Crusades with your forefather, and you shan't touch a stone of it." That was said the other day to the representative of one of the oldest territorial families in Yorkshire. Nor is it long since a daughter of a leading citizen in one of the great towns of the same county, on hinting to his gardener that the family would be rather glad if their greenhouse could be utilized as a vinery, was told without circumlocution that she might tell her father that " he may just choose betwixt me and t'grapes." The former alternative was adopted without hesitation. In neither of these cases did the rough speech indicate the least disrespect, but it did illustrate what may be called the freeholding temper.

And the same temper no doubt manifests itself, here and there in the purely rural districts, and much more in those in which the manufacturing element is diffused, in the absence of some of those exterior courtesies which are so usual in the South and West of England that the neglect of them is apt to be regarded there as an intentional affront. These people are somewhat slow in yielding their confidence to strangers. They will give a welcome to the new comer—the squire's wife from the South, let us say—but she will feel somehow that she is being weighed in the balances. Yet if she wishes to make friends with her husband's people and goes about it in a simple and straightforward manner, quietly and not expecting to carry the position by storm, her success will be very real, and she will know that in the farmhouses and cottages around her new home there are not a few who regard her joys and sorrows as their own. Similarly the rural or semi-rural mind in the North may appear less readily receptive of new suggestions or appeals than that of the agricultural population of the Southern Counties. It needs to be fully persuaded before it will yield outward assent. Its first impulse, is apt to be towards the reply, " I will not," but afterwards in a good proportion of cases the man repents and goes. Its reasoning faculty is vigorous and independent, but very deliberate in its action. It seldom yields submission to authority, but it is much more open to conviction than at first sight appears, and it is not ashamed to acknowledge that it has been convinced even against its inclinations and prejudices. Its outlook again is wider than is usual in the South. The political speaker in most Northern villages finds that considerations and arguments of a general character are readily followed, and indeed are looked for. Altogether the Northern type of character, even before it is brought under distinctly urban influences, is a robuster type than is common south of Trent. The sterner climate has braced it. The element of ruggedness, often of bleakness, sometimes of grandeur, in the scenery, and the breadth of the sweeps of hill or moorland so often visible have perhaps helped to preserve the Northern peasantry from that limitation of interests which is often found where the landscape is richer and more thickly clothed and the horizon is nearer. On the other hand, the sense for beauty seems to be less present in the North. Comparatively seldom are cottages to be found offering themselves as subjects to the artist's pencil. There are, indeed, conspicuous exceptions to be made. Very few English or foreign towns present more attractive material for sketches than Knaresborough or the city of York, than Whitby or Runswick. But, speaking generally, the desire for the picturesque has not given strong evidences of its existence among the dwellers even in the non-manufacturing districts in the North.

When one passes into the industrial districts the absence or restriction of a desire for the beautiful is seen to have become an almost absolute content with the positively ugly. There can be no collection of human dwellings in the world more frankly hideous than the average manufacturing or mining village of the North or than the working-class quarters of the great towns. Again, the shortcomings in manner which have been mentioned as observable even in the rural North develop, under the combined influences of manufacturing and urban life, into habits of generally unintentional, but often enough of actual, rudeness. The roughness with which working men, and working women too, brush against passers-by in the streets is both surprising and almost shocking to persons accustomed to the instinctive street courtesies of even the poorer parts of London. And the roughness and familiarity of address to persons of superior station are also startling. Yet speaking generally, the real essence of discourtesy does not underlie these failings in manner. There is little real indifference to the feelings of others. The rough millhand, who, swinging home from his work, never thinks of " giving the wall " to a lady, and may even jostle her off the pavement, will often, if she asks for the way to any place in the neighbourhood, turn some yards out of his path and give her careful directions by which she may avoid any mistake in reaching her destination. The life of the streets, it may be here remarked, is much duller in the Northern towns than in London. The strong reasoning faculties possessed by the Yorkshire or Lancashire peasant are doubtless strengthened and developed in various ways by the close intercourse with his fellows afforded by urban life. This is seen in the vigour with which public questions, both national and local, are discussed wherever men congregate, in the keen intelligence with which political speeches are followed, and the acute comments by which they are often interrupted. But the agility of intellect which is developed in a generation or two by London life and which shows itself in the clever chaff of the Borough, the sprightly atmosphere of the much-pitied East-end, the badinage of the omnibus and cab driver which commands even French admiration, has little or no counterpart in the great towns of the North. This is a somewhat curious contrast, having regard to the apparent relative stolidity of that Southern peasantry, from which, either directly or by one or two removes, so large a proportion of the population of London must be drawn. In the same connexion it may be observed that the working classes in the Northern towns are very much less provided with evening amusements than the same classes in London. As they are quite well able to afford to pay for such amusements if they desired them, it seems reasonable to suppose that they have fewer cravings in that direction than their brethren in the South. The Northern artisan, indeed, has his recreations, but they are of a more strenuous and exciting type than those which are the chief joy of the London workman. The football match between his own town and another draws him in his thousands, and the great crowds round the field watch every point in the game with an intense and almost passionate interest, which finds vent in joyous cries of encouragement or fierce murmurs of disapprobation. The taste thus illustrated is, for the most part, wholesome enough, and so in itself is the love, also very strong in the Northern workman, of a good horse-race. Not so, by any means, however, is that desire to have " something on " any sporting event, and above all on horse-races, which within the last 30 years has spread with great rapidity among the working classes of both sexes in the North. The prevalence of the gambling fever there is, in truth, an evil of the most unqualified character, and has reached, I imagine, much graver proportions than is the case in London and the South.

One other point, very characteristic both of the Northern artisan and of his neighbours of superior social position, must not go without mention. The element of local corporate unity is very strong among them. They are deeply attached to the town or even to the manufacturing village in which they have been born. Events affecting its reputation or the welfare of its inhabitants move them in a very genuine fashion. This fact gives an element of interest and, so to say, of warmth to life in the manufacturing districts of the North which to a large extent is wanting in the South of England and in London,

though it is true that in the East-end local patriotism has been developed in considerable vigour. No doubt this strong local feeling is a force by no means always brought to bear in the right direction. Pride in the traditions of a town or village may stand, and often has stood, in the way of necessary reform. "It is our way," "it has always been so here," are reasons against progress carrying no small weight even in very Radical constituencies. But none the less is the strength of local feeling a power of great value, which, if guided with wisdom and tact, may be utilized for excellent ends.

On the whole, it would appear that, while life in the manufacturing centres tends to strengthen, on their natural line of development, the obvious excellencies and defects of the Northern rural type, the Southern rural type is distinctly modified by submission to the immense transformation in environment which is involved in settlement in the metropolis. London, in a word, changes in many very important respects the human material brought to its vast factory, but does not change it into the likeness of the Northern artisan. It brings out qualities more or less latent in the Southern peasant, but the result is a compound differing not less, sometimes more, from the mechanic of the North than the villagers in the two regions differ from one another. And thus it is natural that passage from one part of the country to the other should be always accompanied by the sense of change and contrast to which I set out by referring, which has a certain piquancy, and which without doubt opens up many interesting and not unprofitable lines of study.

II.

IRON AND STEEL IN THE CLEVELAND DISTRICT

TWICE during the last month (*The Times*, October 5th and 27th) attention was drawn to the remarkable development which has lately taken place in the produce of the iron and steel industries of this country, and in the amount of that produce despatched to foreign markets. The advance thus recorded involves benefits of a solid kind to a very large number of persons in many parts of Great Britain. The improvement happily, is confined to no one district. In Staffordshire and the Midlands, on the seaboard of North Lancashire and Cumberland, side by side with the textile industries of South Lancashire and the West Riding, and over large areas in Wales and the South of Scotland, the smelting of iron ore and the conversion of the product into wrought iron or steel give occupation to millions of capital, to the energies and organizing abilities of scores of great employers of labour, and to the strength, intelligence, and manual skill of many thousands of workmen. Each of those seats of the iron industry is participating more or less in the present improvement of trade. Each of them presents conditions affecting its local success well deserving of separate study, and as to a few of them, falling more specially within the scope of the present series, some observations may be made further on. To the general reader, however, it is likely to be more interesting that his attention should be specially directed to one great district which has acquired a position of great influence, not to say primacy, in the industry under consideration, and within whose limits the working of iron in one form or other, together with the kindred industries of mining, on the one hand, and manufactures from finished iron and steel on the other, reigns almost to the exclusion of other branches of industrial activity. Such a district is formed by Cleveland together with the adjoining counties of Durham and Northumberland, which from the point of view of the iron trade are commonly known collectively as the " North of England," or sometimes as the North-Eastern district. Within that area, so singularly endowed with mineral wealth and with facilities for the transport of its products over sea, probably about 30,000 men are at the present time engaged on or about the extraction of iron ore from the earth and the various stages of its preparation for the direct service of mankind. Of these, some 5,000 or 6,000 are occupied in ironstone mining, some 7,500 in smelting, and the remainder in the various processes by which the rough grayish blocks, or bars, of metal known as " pigs " of iron, turned out by the smelter, are transformed into " blooms " or " billets," the names given to various shapes in which wrought iron and steel are disposed of to manufacturers to deal with as they list, or into such comparative elementary but still finished products as bars or rails for use on railways, plates and angles for bridges, ships, and boilers, and rolled beams for warehouses, factories, and other constructive purposes.

Their rich coal deposits had long made, and would under any circumstances have continued to make, large parts of the country of Durham and smaller districts in Northumberland important seats of industrial activity, but without iron Cleveland would in all probability have had no industrial existence, except as providing in Middlesbrough a port through which Durham coal might be shipped. It so happened, however, that about 20 years after the commencement of the construction of the port of Middlesbrough, which was made close to a spot on the south bank of the Tees, where, within the memory of men still living, there stood a solitary farmhouse, there was discovered at Skinningrove, a few miles to the east, the great bed of Cleveland ironstone. That was about 1849. Hints of the mineral wealth of North-East Yorkshire had not, indeed, been wanting in previous years. From near Whitby and other places along the shore northwards towards

Saltburn since 1835 ironstone had been worked from the seam and carried by sea to the Tyne for smelting, while for a much longer period detached masses of ferruginous rock found on the beach at various points along the same coast had been shipped, when weather permitted, and conveyed to ironworks which had been established in Durham and Northumberland, in the vain hope that the iron ore deposits found amid the vast coalfields within their immediate neighbourhood might prove sufficient. Whether the Whitby source of supply would ever have attained considerable proportions is, indeed, very doubtful. But the discovery of the great Cleveland bed, first at Skinningrove and shortly afterwards at Eston, at once relieved one of the most picturesque and historically interesting neighbourhoods in northern England from all danger of disfigurement, and rendered possible, and, indeed, inevitable, an immense development of the iron industry on Tees-side. There was the ore, soon shown to be present in quantities which at that time, and perhaps even still, might fairly be regarded as limitless. There was the Durham coal, the shipping of which had been Middlesbrough's original *raison d'être*, very ready to be stopped there for so good a purpose. There were the capital and the enterprise thirsting for profitable employment and rejoicing to take so splendid an occasion by the hand. Moreover—and this where it existed was a great advantage—many of those who possessed or acquired land in the iron belt possessed also coal mines, and sometimes limestone suitable for use in the blast furnaces as well.

In such circumstances a great industry was bound to spring up. Labour, indeed, was wanting, but severe though much of the work is, the wages offered for it, even in its lower grades, drew workers from almost all parts of the United Kingdom. Not in large numbers, curiously enough, from the agricultural districts of Yorkshire, but from Ireland, the Midlands, Wales, and other districts they came and settled in or about Middlesbrough and elsewhere in Cleveland and in Durham, where the ready accessibility of the Cleveland ironstone conduced to the establishment and development of ironworks. Here, as elsewhere, the Irish have been found ready to undertake and carry on labour of a very arduous character. A large proportion of the men engaged about the blast furnaces are of Irish birth or descent, and so are many of the puddlers. But among the latter class of workmen and the other more highly skilled hands in iron and steel works the majority are probably drawn from districts such as Staffordshire and parts of Wales, where the iron industry was well established before the discovery of the great Cleveland bed, but where the vicissitudes of the trade, accentuated doubtless in some cases by its great development in the North, decided many men of energy to seek occupation and promotion there. The ironstone miners, again, though mainly drawn themselves, or their fathers, from agricultural districts, do not represent the dalesmen of the North Riding or the dwellers in the plains of York or Mowbray nearly so much as the peasantry of the eastern counties or other more remote parts of England. Thus it will be seen that the growth of the iron trade in Cleveland has involved the creation of a colony remarkably homogeneous in its occupations, but not less heterogeneous in its composition. Such conditions ought to result, in a few generations, in the production of a distinctly differentiated and very interesting type. The Irish element, indeed, keeps very much to itself, lives in Irish villages or quarters, and retains the Roman Catholic faith, the population adhering to which is therefore so large, although Cleveland has few, if any old Roman Catholic families of position, that since 1879 Middlesbrough has been the seat of a Roman Catholic Bishopric. But the other sections of the population, though so diverse in origin, intermarry freely and must make a remarkably complete blend of varied strains of British blood. A mixture equally complete may exist in London, but under very different influences. If any occupation can exercise a definite effect on character, that of a worker upon iron or steel must surely do so. There is none in which the worker is brought into more intimate daily relations with the elemental powers. I do not speak here of the ironstone miner, as to whom some remarks will seem appropriate in a subsequent article on Northern mining generally. But from the moment when the lumps of metallic rock, hacked from the heart of the neighbouring hills, or, it may be,

borne oversea, as is a large part of the ore now used in the Cleveland district, from outlying heights of the Cantabrian Chain in Northern Spain, are brought to the blast furnace, down to the moment when the finished product of the iron or steel rolling mills is stacked for sale, the workmen employed are in visible alliance with the most mighty forces of nature in a vast transforming operation. A similar alliance, no doubt, exists in the case of many modern manufactures. But in very few, if any, of them is the connexion so conspicuous as well as so constant as it is with the workers in iron.

In speaking first of blast furnaces, it should be mentioned that to the Cleveland ironmasters was due the initiation of the series of developments in size and improvements in construction and methods of working, which have led to the great increase in the output of pig-iron. The records of one of the principal firms in the district, as I know, show that the tonnage of pig iron turned out per furnace at their works was, in 1890, more than three times, and, in 1893, nearly five times what it was in 1854; and the increase continues. This immense development in productive power has not been accompanied by any very striking changes in the general appearance of blast furnaces. But the element of impressiveness, almost of grandeur, about them is never wanting. In their general outline resembling vast windmills, without the sails, and with tapering bases, flankes by supporting pillars, these structures receive at the top, in fixed proportions, barrow-loads of iron ore, coke, and limestone, while through apertures near the foot, called tuyeres, blasts of hot air are driven with tremendous force and at a temperature ranging from 900 deg. to 1,500 deg. Fahrenheit. Once lighted the furnace is kept "in blast" for years, and the action of the gases generated by the upward movement of the hot blast through the slowly descending masses of ironstone, coke, and limestone liberates, or "reduces," the iron by the withdrawal of its combined oxygen. When the materials charged arrive at the lower part of the furnace, known as the "zone of fusion," the fuel is consumed, and the iron and the earthly portions of the ore, assisted by the limestone, are melted, the latter forming a slag. This and the fused iron descend into the well, where separation takes place, the heavier iron sinking to the bottom. When the well is filled with molten matter the slag, floating on the top, runs in a continuous stream under the superintendance of a "slagger," into vessels prepared for its reception, and is subsequently deposited upon the sides of the miniature mountains which form a conspicuous feature on the banks of the Tees. Three or four times a day the bottom of the hearth is tapped. Then the molten metal issues forth, a stream of gleaming gold, and courses down the channels prepared for it into a sandy bed divided into compartments some 3 ft. long, where cooling it speedily loses its beautiful tawny colour and turns to the dull gray of the well-known pig-iron. The operation is one full of interest, sometimes even of excitement. The art of judging from the appearance of the outflow of slag whether the molten metal below it has reached the condition in which it may properly be tapped, the skimming of dross from the surface of the glowing stream, the dealing with such emergencies as arise from time to time when there is a "break away" and the molten flood discards the channels made for it and rushes in every direction over the pig beds—all require no small judgment and address as well as coolness of head on the part of the workmen employed at the front of the furnace. And the furnaces, always spoken of, by the way, as of the feminine gender, are liable to many most distressing maladies—maladies which, having regard to the tremendous heat always maintained in their interior, it is extremely difficult to diagnose and still more difficult to cure. As those most familiar with their ways will tell you, a course of treatment found perfectly satisfactory in removing a check to the healthy working of a furnace on one day will prove a complete failure on another, although even to the learned eye "her" symptoms are precisely the same as on the former occasion. None the less, indeed all the more, is it needful that many of the workmen engaged in this operation of turning ironstone into pig-iron should be vigilant, intelligent, and skilful.

But that is only the first stage in the transformation. The products of the blast furnace must be followed to the puddling forge or to the steel works, and, in either case, on to the rolling mills. And here we come upon processes which are to a considerable

extent rivals of one another, and certainly present great elements of contrast. The puddling furnaces of Cleveland, and of the iron districts generally, notwithstanding that a vast amount of ingenuity has been applied both here and on the other side of the Atlantic to the discovery of mechanical substitutes for the very arduous and exhausting work of the puddler, remain very much what they were 50 years ago. You still see two men standing in front of a long low furnace, within which they manipulate, with long iron instruments, a mass of semi-liquid metal. They are not chemists, but they are assisting nature to perform a very important chemical operation—the liberation of the pure iron in the pig from the foreign impurities still blended with it in that form. They first "fettle," or line, their furnaces with substances, commonly oxide of iron in the form of hematite ore, which will both make good the wear caused to the interior of the furnace by the previous charge and promote the oxidation of the impurities just referred to—in particular carbon, silicon, sulphur, and phosphorus. Then they throw in the "charge," consisting of pieces of pig-iron broken up conveniently for the purpose and weighing about 5 cwt., and shut the door. There is a great coal fire at one end of the furnace-hearth, the flaming gases of which are ever drawn across the charge of iron by the draught of the chimney stack at the opposite end. In about 40 minutes the pig-iron, which melts easily, reaches a condition of blue effervescence, which is called "boiling," and is produced by the burning off of the carbon. Then, the carbon having for the most part disappeared, the purified iron, which, it should be observed, requires a much greater heat than that of the puddling furnace to melt it, subsides into a pasty condition, and the puddlers' chief work begins. It consists in stirring about and turning over the viscous mass of metal so as to secure that the oxidizing flame shall reach every part of it, and with the aid of the "fettling" disengage in the form of gas or slag all the lingering impurities. The men relieve one another every few minutes, for the labour is very arduous, and then, when the increasingly pasty consistency of the metal bears witness to the great purification which has been effected, they collect it into balls, in which form it is borne off on a truck, or bogey, and, amid gleaming showers of sparks, subjected to the mighty impact of the steam hammer, or squeezer, to expel the particles of slag mixed up with it. That expulsion, with the accompanying additional closeness of grain acquired by the iron, is carried further and further by the pressure of a succession of powerful grooved rollers. The rough or puddled bars are then cut into short lengths, piled one on another, and reheated to a welding heat in a suitable furnace, whence they are taken to the finishing mills. The bars of wrought iron issuing from these processes are essentially different from the pig-iron as it went from the smelter to the puddler. They have acquired new properties of ductility, tenacity, and weldability, and they are fit either for the smith or to be rolled into rods, rails, plates, and other finished products.

Such in meagre outline is the course of the production of wrought iron, which is usual in Cleveland and general in the iron districts. It is impossible to touch here upon a variety of alternative processes which are in use in certain works. Some brief reference, however, must be made to the production of the high quality of wrought-iron, known everywhere as "best Yorkshire," at a few large establishments in the West Riding. At these works special kinds of ore and of coal, obtained locally, are employed, a cold instead of a hot blast is used (as was universal before 1816 or thereabouts) in smelting, and the resulting pig-iron, which fetches more than double the price of the best ordinary pig, is subjected, before puddling, to a refining process by melting it in large open fires with non-sulphurous coke. The wrought-iron thus obtained sells for double the price of Staffordshire and considerably more than double that of Cleveland wrought-iron. Yet, though for certain important purposes, which will be alluded to later on, "best Yorkshire" and the cheaper wrought-irons still command a considerable sale, the work of manufacturing them is a much decayed branch of the great iron industry. Of that fact fresh evidence has been recently afforded by the closing of the great Bowling Iron Works near Bradford in this year of revival in the industry. The explanation, of course, is that not only step by step, but by leaps and bounds, the use of steel has come into favour at the expense

of wrought iron. Five-and-thirty years ago steel could hardly be said to be produced on a wholesale scale. Its manufacture was then practically confined to the old crucible process, by which a fine metal was produced for the making of tools and weapons and some of the more delicate parts of machinery. A considerable but limited quantity of costly steel is still turned out by much the same old method, and put to similar uses, particularly at Sheffield and in the Midlands. But the making of steel at a cost at which it could be applied to the general purposes for which iron can be and has been applied is a state of things the beginnings of which are within the recollection of persons in early middle life.

Broadly speaking, the substitution of steel for wrought iron has taken place in two great stages. First came Sir Henry Bessemer's great invention, the practice of which affords perhaps the most splendid spectacle to be witnessed in any of the arts known to mankind. Its effect is to burn out all the carbon and silicon in pig-iron by a method which develops, in so doing, a degree of heat sufficient to keep the purified metal still liquid. This is effected by the brilliantly simple expedient of driving a blast of atmospheric air of tremendous power—about 21 lb. to the square inch—upward through a vast cylindrical vessel charged with molten pig-iron. The charge is received while the huge vessel, known as the Bessemer "converter," some 19 ft. long, with a diameter of 7 ft. or 8 ft., is in a recumbent position. It is then raised into an almost vertical position by an ingenious mechanical arrangement, which at the same moment turns on the blast. There is a roar as of a mighty tempest against the face of a precipice. From the open top of the "converter" there issue volumes of smoke coloured by reddish flame and gleaming showers of sparks. But that is only the prelude to what we are to see. Before ten minutes have passed the smoke clears off and there surges upwards a torrent of yellow flame streaked with fragments of slag and sparks of molten iron cast off by the furious chemical ebullition raging within the vessel. For six or seven minutes more this magnificent spectacle continues, the column of flame growing more and more brilliant till it approaches to almost absolute whiteness. Then it begins to fade, and in two or three minutes more the flame drops and it is known that the blast has done its work. Indeed, it has done it too well. If the purified fluid metal were at once drawn off after the blast it would be useless. There are bubbles of air entangled in it, which would make it break up if it were rolled. And with no carbon left at all it would be far too soft and yielding for any serious work, even if it could be rolled. These defects are remedied by the introduction of a carefully-measured quantity of spiegel iron, a kind of pig-iron singularly free from all impurities except manganese and carbon. The manganese, the introduction of which was devised by Mr. Mushet, absorbs the entangled gas, and the carbon gives back to the excessively decarburized metal the solidity it needs. One more fierce ebullition is caused by the introduction of the spiegel iron, and the charge is then tapped into a ladle and cast into ingots to be rolled into any article required.

It is a wonderful process alike in conception and in execution, and the economic effects of its establishment have been great. Within a dozen years after it came into full commercial working, it had killed the great trade previously existing in iron-rails. In 1873 the make of iron-rails by certain leading firms, in the north-eastern district alone, who periodically made returns of their production for purposes connected with the adjustment of wages, was 324,000 tons ; in 1879 it had sunk to 6,769—truly an enormous and terribly rapid displacement. Moreover, the establishment of the Bessemer process in the only form in which it was at first known had a decidedly unfavourable influence upon the Cleveland district, for even the awful purgatorial fires of the "converter" failed to cast out or even to reduce the element of phosphorus in the pig-iron, and as that element is specially prejudicial to the value of finished iron in any form, the pig-iron sent to the "converter" had to be drawn from ores containing a very small percentage of phosphorus. Such are the hematite ores of North-West Lancashire, Cumberland, and the Biscayan province of Spain, and such are not those drawn from the great Cleveland bed. Thus, while an immense impetus was given to the industrial development of Barrow and the

north-west—an impetus of which the energy and resource of the late Sir James Ramsden did much to enable that district to avail itself—the ironmasters of Cleveland and the north-east were put through a doubly severe discipline. For a brief period indeed there seemed reason to suppose that the extension of the use of wrought iron in shipbuilding might make up, and even more than make up, for its practical disuse for the permanent way of the world's railroads. The make of iron-plates by the north-eastern firms above mentioned rose from 177,000 tons in 1872 to no less than 440,000 tons in 1883. But then the ebb set in. In 1885 the total tonnage had sunk to 205,000, since when it has only in one year, 1889, again reached 200,000, and has thence fallen steadily to the humble figure of 53,000 in 1895. These figures illustrate the second stage of the displacement of wrought iron by steel. They are not explicable by the development, great as it has been, of the produce of Bessemer "converters," not even when we take into account the ingenious adaptation associated with the names of Messrs. Thomas and Gilchrist, Mr. Snelus, and others, and known as the "basic Bessemer" process. This consists, briefly, in substituting for the silicon, which is, chemically speaking, an "acid," lining of the original "converters" a "basic" lining, for which purpose a dolomitic lime is generally used. Besides this change in the converter itself, a considerable quantity of ordinary quicklime is added to the charge, which draws off the phosphorus present in excess in Cleveland and other non-hematite pig-iron, and and thus enables those classes of iron to be converted into steel nearly as readily, and for most purposes as usefully as is the case with the Barrow and other non-phosphoric ores. Indirectly the maker of wrought iron obtains some benefit from the working of the basic process. For as that process provides a certain means of oxidizing the phosphorus in pig iron, in which it is largely present, its presence becomes an actual advantage, since its oxidation, like that of the other impurities eliminated, is a source of largely increased heat in the "converter." Now, phosphorus is largely present in the "puddler's tap," or "tap cinder," which is drawn off as slag from the puddling furnaces, and so that waste product, which for many years was such a drug that ironmasters were put to considerable difficulty in disposing of it, now sells at seven or eight shillings a ton to the ironmaster who wishes to make pig iron suitable for the basic converter.

It is not either of the Bessemer processes, "acid" or basic," or both of them together on which must be laid the responsibility for the greatly accelerated decline in the wrought-iron industry since 1883. That is to be put to the account of a remarkable development in another and strongly contrasted method of making steel—what is known as the Siemens-Martin open-hearth process. The chief features of this process are its relative slowness—a "heat" occupying about seven hours—and the extraordinary intensity of the heat maintained during its progress by means of the "regenerative" gas apparatus specially associated with the name of Sir W. Siemens. That apparatus provides double sets of chambers, through one or other of which streams of heated gas and air respectively are being constantly introduced into the furnace, while the set not in use for that purpose, serve as passages for the waste gases towards the chimney and absorb on the way far the greater part of the heat which those gases bring with them. Every half-hour or so the current is reversed, and the chambers which have been thus accumulating heat are shut off from the chimney and turned into the inlets for air and gas, which by passing through them take up much of the heat which they have absorbed. The new streams thus enter the furnace at a temperature which is not likely to be much lower than that which they find there, and which the combustion of each new current of gas, as it meets the current of air at the mouth of the furnace, greatly intensifies. In this way the heat of the hearth, on which pig iron is laid first to serve as a "bath" for a large quantity of steel scrap, rises ever higher, up to the tremendous reading of 3,500°, Fahrenheit. It is totally impossible to look in when the working door is opened, for more than an instant, without the protection of coloured glasses. The constant play of air over the molten metal, assisted by the presence of oxides of iron in the charge, secures the oxidation of the deleterious elements, and at intervals samples are taken and examined to ascertain

the completeness with which that elimination has been accomplished, and in particular whether the charge has been brought to the degree of decarburization at which it can be tapped at once, or, beyond that, to the point at which, as in the Bessemer process, a measured quantum of carbon should be added. It is this possibility of watching and testing the results of the process and introducing fresh elements exactly when required which gives the slow though very impressive Siemens-Martin process a decided advantage over the dramatically rapid Bessemer " converter " in turning out steel capable of being rolled into plates and angles for shipbuilding and other constructive uses. Nor is it surprising, on the other hand, that the produce of that mighty embodiment of modern metallurgical science which I have just described has in several directions ousted the produce of the archaic puddler's furnace from the favour which until 15 years ago it still enjoyed. Without going into other branches of a complicated subject it will be readily apparent that for many, though not by any means for all, purposes the homogeneity of steel which has been melted under great heat, especially if its production be as carefully watched and directed as is possible with the Siemens-Martin open-hearth furnaces, must give it important advantages over wrought iron. The latter product is a substance consisting of minute granules of iron which have been compressed and welded together, more or less perfectly. Thus it tends under certain forms of wear to " peel " in flakes instead of wearing down evenly like steel. Even so there are important uses, apart from those of the smith's forge, where it still reigns almost supreme, for which the best wrought iron is preferred even to open-hearth steel. " Best Yorkshire " iron, for example, is still used by all the railways of Great Britain, the colonies, and India for those parts of their locomotives and rolling stock—the shackles and drawgear—where sound welding and resistance to percussive shocks are specially required, and wrought iron from the Cleveland district is employed by the Admiralty for cables. For the construction of certain parts of ships and boilers which are specially liable to corrosion, wrought iron is also still preferred. It is quite possible that the fibrous quality which, as has been indicated, is the result of the puddling process, may, though from some points of view a defect, prove the means of retaining, as it were, an inexpugnable citadel for the wrought-iron industry. Yet how small, at the best, is its domain compared with that which once it occupied !

The change, as we have already indicated, involved very severe trials for the ironmasters and iron manufacturers of Cleveland. To form an idea of the money amount of the losses which they endured is not easy, but their gravity may at least be illustrated by the facts that whereas there were in 1871 more than 1,860 puddling furnaces in the north-eastern district the number in operation there at the present busy time is probably not more than 300—a drop of 1,560—and that the outlay represented by each puddling furnace and its accesory appliances is about £1,000. Further, it is to be borne in mind that in most cases the finishing or rolling mills in use in the old ironworks were not strong enough to be used for dealing with steel ingots, from the Bessemer " converter " or the Siemens-Martin furnace. Varying estimates may be based upon these facts and figures, but none which does not point to the virtual destruction of a very large amount of capital. Only those ironmasters and iron manufacturers who were able to command large pecuniary resources and who were endowed with special energy and enterprise could grapple with the situation thus created, and under its stress more than 40 houses which once flourished in the North-Eastern district succumbed. That fact, it need hardly be said, must have represented a large amount of distress among workmen who lost their employment. In great establishments where there was capital enough to substitute Siemens-Martin plant for the puddling furnaces the process was gradual, and although it was necessary, in the first instance, to import some new foremen with experience of open-hearth work, that work is so much akin to the puddlers' old occupation that, after being trained as second and third hands at the first of the new furnaces, some of them proved able to take the leading places as more of the Siemens-Martin plant was introduced, and of the rest a good proportion were probably re-absorbed in other departments as the total output increased. Fortunately, the rolling mills for dealing with the steel ingots, though more

powerful and costly, so closely resemble in their general arrangements the rolling mills to which the puddled bars were and are still consigned that there was very little difficulty in transferring workmen from one to the other. This was well, but any one not familiar with the iron trade, who has followed the story so far, will reflect that the great changes in that industry, which have been briefly noticed, must have involved many occasions, in individual works, and in the district at large, for more or less serious disputes between employers and workmen, and must desire to know how such disputes were obviated or surmounted. To that very natural inquiry I propose to furnish some answer in my ensuing letter.

III.

IRON AND STEEL IN THE CLEVELAND DISTRICT (*Concluded*)

IN the preceding article an attempt has been made to sketch the general aspects of life in the industries of iron smelting and manufacture and the production of steel on the great scale on which those processes are carried on in Cleveland and the adjoining districts. We have seen how everybody, or almost everybody, engaged in those industries is daily brought, in a peculiarly impressive manner, face to face with the most mighty powers of Nature and forced to realize that it is with those powers that he is allied in bringing about wonderful changes in the composition and mechanical qualities of the main substance with which he is dealing. It is, no doubt, a subordinate alliance to which those mighty physical forces are reduced, but none the less do they need very respectful handling. The slightest momentary forgetfulness or disregard of their habits of action on the part of a single workman may involve heavy loss to his employer and terrible injury, perhaps death, to himself and others. From time to time, too, as we have seen, the conditions of the industry have been subjected to wide-reaching changes through the invention of new processes or the improvement of old ones, by which new knowledge as to Nature's more hidden workings has been brought into useful application : and changes of this kind have entailed, and might entail again, burdensome and even ruinous sacrifices to the employer and prolonged and even lasting loss of employment to the workman. I cannot tell how far the fact is due to the peculiar discipline afforded by the sets of circumstances just mentioned, but certain it is that in the iron industry there has been developed, in a very special degree, that recognition of the fundamental unity of the interests of masters and workmen which is the best security for industrial peace. Time was, indeed, when the iron manufacture of Cleveland was at least as much disturbed by disputes between capital and labour as any industry in any part of Great Britain. In each of the years 1862-65, inclusive, strikes occurred, and in 1866, by a mixture of strike and lock-out, the industry was at a standstill for nearly five months. In the end the men, who had resisted a reduction of wages on which the masters insisted, were completely defeated. They had suffered much hardship during the struggle, and the masters, although victorious, had lost a great deal.

The time was opportune for a propaganda of peace, and the men to conduct it were there in the persons of Mr. (now Sir) David Dale, who was honorary secretary of the Iron Manufacturers' Association, and the late Mr. John Kane, secretary of the Ironworkers' Union. They and other leading men on both sides had been profoundly impressed by the success of the board of conciliation for the hosiery trade of Nottingham, established in 1860, mainly through the efforts, and worked for many years under the presidency, of Mr. Mundella, in preventing strikes and developing friendly feeling between employers and employed. With all their influence and persuasive power they urged upon the members of their respective associations the wisdom of trying a like experiment in their own trade. After rather more than two years of reflection thus stimulated opinion was ripe, and the Ironworkers' Union, in March, 1869, made a definite proposal to the employers, which the latter immediately accepted, for the establishment of a board of conciliation and arbitration for the manufactured iron trade of the north-eastern district " constituted and arranged on Mr. Mundella's scheme." In a few weeks' time the board was established, with Mr. Dale as its first president. His admirably fair and skilful management was, by universal acknowledgment, of immense service in steering through the period of initial difficulties when it was still a strange experience for representative masters and workmen to be meeting on equal terms ; and when, after six years' tenure, he resigned the chair,

a belief, not only in the theoretical excellence, but in the practical value of the principle of conciliation, with arbitration in reserve, was firmly rooted in the mind of the iron manufacturing community of Cleveland. Mr. Dale was happily followed as chairman of the Board by a like-minded employer, in the person of Mr. William Whitwell, who still holds that important office ; while on the men's side the conciliatory work of the late Mr. Kane has been carried on by Mr. Edward Trow, as operative secretary of the board, with great stanchness and ability. And now, after nearly 28 years' working, it can be truly said that no human institution was ever more entirely successful than the "Board of Conciliation and Arbitration for the Manufactured Iron and Steel Trade of the North of England" in securing the ends its promoters had in view. During the whole of that period, with exceptions so few and slight as not to deserve mention, the board has entirely prevented the stoppage of work through labour disputes. More than 80 general questions of wages, affecting many thousands of workmen, have been settled by its agency.

The method of settlement has varied. In the earlier years of the board's life an eminent outsider was generally called in as arbitrator after the representatives of both sides had approached as near to one another as they could by friendly discussion across a table. Latterly this procedure has been felt to be needlessly cumbrous, and the system which has now for many years been in use, in regard to wrought-iron workers, is the automatic adjustment of wages by a sliding scale fixed with reference to the prices of leading products of the trade as declared by a London accountant after examination of the books of the firms in the membership of the board. From time to time the bases of the sliding scale employed for these adjustments of wages have been altered, sometimes as the result of discussion at the board, and perhaps more frequently of arbitration. The net result of these changes of basis has been distinctly favourable to the men, but the actual operation of the automatically working scale has, of course, necessarily been in many cases to cause a reduction in wages. There has never been any difficulty in securing the acquiescence of the men in such reductions. Indeed, so far as I know, there has never been any serious apprehension that difficulty would arise. In regard to steel wages, the wrought-iron sliding scale just mentioned naturally does not operate, but any questions of difficulty between masters and men in steel works in the membership of the board are referred to it for settlement ; and the aim of the board is to promote, as far as may be, sympathetic arrangements of rates of wages in the manufacture of steel and iron, so that the fluctuations may be more or less parallel. Here, again, the workmen, as a rule, are very reasonable, under the guidance of their judicious leaders. On both sides there have been developed a strong spirit of mutual good will and a deep appreciation of the economy of industrial peace, which render the idea of a return to the old state of intermittent strike, with its bitterness and waste, utterly distasteful.

The operation of the conciliation board, moreover, is far from being confined to the direct or indirect determination of general wages questions. Every year it appoints from among its members a standing committee composed, like itself, of an equal number of employers and operatives, and presided over by Mr. Whitwell, before which comes for consideration every question of difference between any set of workmen or individual workman at any works connected with the board and their employers which cannot be settled by discussion between the parties with the aid of the operative representing the works concerned on the board. In the great majority of cases questions thus brought before the standing committee—a body of 12 members—are settled by conversation across the table. If they desire more information as to the details of the matter, they appoint a sub-committee of two or four of their number to visit the works and bring up a report, which is almost invariably adopted as the decision of the standing committee. But if, for any reasons, an agreement, or at least a majority vote, cannot even so be arrived at, the question is placed before the standing referee, who for many years has been Sir David Dale, and his judgment is final. By one or other of these means no fewer than 1,200

local questions, which might possibly have lead to stoppage of work or much heartburning, have been peacefully settled. Not only so, but it will be seen that within the range of the board's operations the possibility either of oppression of individual workmen by a narrow-minded or prejudiced manager, or of a single firm by a powerful trade union, is entirely neutralized. Thus the board, as has been well said, is " a conscience " for the trade. It brings to bear upon points of difficulty and doubt in the mutual relations of employing firms and their workpeople the cooler and more detached judgment of the representatives of other masters and other workmen, formed after hearing the whole case, and that judgment prevails. And the board's influence extends beyond the works which are in membership with it. It does not embrace all the works, or even all the largest works, in the north-eastern district ; but, so far as general wages are concerned, its decisions carry so much weight that cases are very rare in which adjustments closely corresponding to those made by the authority of the board are not effected, by equally pacific means, in the iron and steel establishments which owe it no formal allegiance. And its influence is far from being limited to the Cleveland district and the counties of Durham and Northumberland. In the Midlands there is an " Iron and Steel Wages Board," which, formed in the first instance in Staffordshire, has gradually extended its representative range until it is fully constituted for both divisions of that county and for East Worcestershire and Shropshire, and also influences the wages of ironworkers in Lancashire, Derbyshire, and the West Riding. For 20 years this beneficent agency has successfully dealt with every dispute referred to it. Its arrangements and practice are very similar to, though not in all respects quite identical with, those of the North-Eastern Iron Conciliation Board, and that organization is recognized with respectful gratitude by the friends of industrial peace in the iron trade of the Midlands and elsewhere as having shown them the " more excellent way."

At a later period in the present series reference must be made to the degree in which the practice of which the manufactured iron and steel trade of the north-eastern district has afforded so striking and satisfactory an example, has spread to other industries in the same part of England. Enough, however, has been said to show that, in respect of the improvement of relation between employers and employed, the industry which has grown out of the discovery of the great Cleveland bed of ironstone has done admirable pioneering work. It would not at the same time be a correct inference that in all respects the iron industry of the north-eastern district presents a model towards which those interested in other industries should seek to approach. There can, I think, be no real doubt that the hours of work in that district are undesirably long. Alike in the manufacture of iron and steel, and at the blast-furnaces, a 12-hour shift is the almost universal arrangement. That is not to say that many, if indeed any, men are actually engaged in manual toil for 12 hours on end. Probably only a small proportion are actually working for more than from $8\frac{1}{2}$ to $9\frac{1}{2}$ hours in each shift. As has been already observed, the workmen are in partnership with Nature in the production of certain chemical and physical transformations, and Nature takes time for her share in the work, during which her human confederates must often leave her to herself. But the majority of them cannot quit their posts until they are relieved by the men of the next shift. Great damage and waste would ensue if they were not on the spot to take up their share of the process when Nature's operations have reached particular stages—if, for example, the " tapping " of the liquid steel from the Siemens-Martin open-hearth or of the molten iron from the blast furnace were delayed beyond the right moment, or if the " rabbling " and the " balling " of the mass of glowing iron in the puddling furnace were not begun at the points when the need for those processes respectively is indicated by the condition of the metal. In many cases, moreover, during the intervals between their regular periods of active work watchful attention is required from the ironworkers with a view to vigorous intervention if things should appear to be going wrong ; and even when that is not so, the intervals are not, as a rule, long enough to make it worth while for the men to go home until the end of their shift.

I am not prepared to say that a system of this kind is necessarily injurious to the health of the men concerned. None but men of robust physique, indeed, could long sustain the fatigues and endure the heat connected with much of the work required for the production of iron and steel, and any latent constitutional weakness is pretty sure to declare itself in such conditions. On the other hand, there must be very real advantages as well as attractions to naturally healthy and vigorous men in the fresh air which usually prevails in ironworks, while the work about blast-furnaces, noxious as, no doubt, are the gases given off at certain parts of the smelting process, is done under the open sky. At the same time, it is hardly possible to suppose that men who are engaged for 12 hours a day in or about the great processes which result in the making of pig-iron or the manufacture of wrought iron or steel can have much leisure either for the cultivation of home life or for the development of intellectual tastes. It is much if the thirst which is naturally engendered by work in the neighbourhood of furnaces does not lead to habitual excess in drink. That there is still a considerable amount of intemperance among blast-furnacemen cannot be denied, but the general body of ironworkers, judging from the opinions of persons in Cleveland who have had them continuously under observation for a very long period, have fully shared in the general advance of the English working classes in sobriety and thrift. Street drunkenness is now comparatively rare, and the scenes of riot which were frequently to be witnessed at railway stations on the occasion of cheap trips are said to be altogether things of the past. The ironworkers have learned how to enjoy their leisure, when they get it, after a more rational fashion than in former days. They save more of their wages, and they spend more wisely. Large numbers of them belong to friendly and co-operative societies, and they and their families are better clothed and fed than they were a quarter of a century ago. And with this development of an enlightened self-interest there has continued a readiness to give freely to the aid of comrades or neighbours in distress. I have been assured on unimpeachable authority that many men in Middlesbrough went without their dinners at the time of the great Durham coal strike a few years ago in order to send relief to the suffering miners, a sacrifice which, when the nature of the ironworkers' employment is considered, affords an astonishing evidence of goodness of heart.

In view of all these facts, it can hardly be contended that the long hours of work, of which mention has been made, have constituted a general bar to the advancement of the moral and social condition of the great body of the ironworkers, except, perhaps, to some extent in the case of the blast-furnacemen. Nevertheless, as has been said, such hours must be hardly compatible with the enjoyment of domestic life and with intellectual development. One might more readily expect a man who hunted or shot for his livelihood from 6 to 6 every day in the week all the year round to be able to see much of his wife and family and to improve his mind. Yet, as a matter of fact, there is not only no general desire among iron or steel workers for a reduction of hours, but a strongly preponderant feeling against a change. The main explanation of this may be supposed to lie in the circumstance that the wages of the great majority of the workers in question depend on the tonnage of metal turned out. It is usual for a puddler, for example, to work off six "heats" in his shift of 12 hours, and he makes at present rates from 6s. to 6s. 6d. a day. If his shift were reduced to eight hours, he might conceivably work off five heats, but certainly not more, for Nature declines to be hustled in her operations. Obviously, therefore, if his rate of wages remained the same his daily receipts would be reduced by at least a shilling, which would be a very serious matter for him indeed. But, apart from that consideration, there appears to be a widespread dislike to any change. At first sight it seems hardly credible, and yet there can be no doubt as to the fact, that one of the very few serious approaches to a strike that have taken place within the range of the Conciliation Board for the manufactured iron and steel trades of the north-eastern district occurred at one of the large works in the membership of that Board *against* the introduction of an eight-hour day, even though the firm concerned had raised their tonnage rate of wages so as to secure their puddlers the same daily receipts as under the 12-hour shift. The experiment

was abandoned and the 12-hour shift restored. This very curious incident may have been partly explicable by the preference of the men for working a long day with considerable intervals rather than a short day continuously, and at high pressure, but in part it must also, I think, he attributed to an unreasoningly conservative adherence to old methods. Whatever the explanation, the story certainly illustrates the contentment of the iron-workers generally with the present conditions of their employment.

To this contentment, however, a certain amount of exception must be made in regard to the blast-furnacemen. Their general relations with their employers are good. Their rates of wages are settled by a sliding scale, having reference to the price of a certain quality of pig-iron, and there is a joint committee of employers and iron-workers which deals with questions of difficulty arising at particular works. That is all satisfactory. More than once, however, in recent years the Cleveland Union of Blast-Furnacemen have made formal application to their employers to reduce their working day from 12 to 8 hours. To these applications the reply of the masters has been, in general terms, that they had no objection in principle to the change in question, but that the condition of trade did not warrant their assenting to any change in the conditions of work which would enhance the cost of the production of pig-iron, and that no scheme had been presented to them on behalf of the men which would avoid a material enhancement in that cost. The wages of the men engaged about blast furnaces are day-wages, supplemented by a bonus on the tonnage of pig-iron turned out in a week beyond a certain quantity. The bonus varies with the importance of the work ; but as in all cases the larger proportion of the wage, and generally much the larger proportion, is for the day's work, it is plain that if there were three sets of men working eight hours instead of two working 12 hours per day the total cost of labour to the employer would be very seriously enhanced unless the rates of wages were very considerably reduced. There would indeed be a certain economy to be taken into account. At present—and it is a very unsatisfactory feature of the existing system—in order to secure that the men employed may alternate weekly from day shifts to night shifts, half of the regular hands are on duty for 24 hours on end every other Sunday, and for that extraordinary protracted spell of work they receive the wages of three shifts. The necessity for this essentially undesirable arrangement, and for the extra cost it involves, would disappear under a system of three eight-hour shifts in the day ; and there might be some reduction in the number of men kept about the furnaces to supply the places of those who are " stopping off " work. The savings thus effected, however, would, it is credibly maintained, fall far short of balancing the extra charge involved by the large and constant addition, amounting probably to about 25 per cent., and possibly more, which the eight-hour shift would produce in the total number of men regularly employed, unless, as has been said, the rates of wages were very seriously lowered. This is no mere question of *a priori* calculation. For the last six years the eight-hour shift has been in force at the blast furnaces in the Cumberland and North Lancashire iron districts, and it is claimed that, as might have been hoped, the general condition and social standards of the men have undergone considerable improvement. But, although they agreed to a reduction of about 2d. a day in wages, applying to about three-quarters of their number, and though it is alleged on their behalf that by greater regularity in charging the furnaces they have secured a turn-out better in quantity and quality than under the old system, it is denied on the masters' part that this improvement has taken place, and it is affirmed that the losses under the new system have caused the closing of many works. In the north-eastern district itself four or five firms have tried the eight-hour shift. Of these one or two have already reverted to the old arrangement, and a third, who introduced it under what appeared to be specially favourable conditions, have been much disappointed in its economic results. In their case the workmen acquiesced in reductions in their wages very much larger than those which were arranged on the north-west coast, and the furnaces have been more regularly charged than used to be the case. Yet, even so, there has been no substantial increase in the output, though a substantial increase was needed, and had been hoped for, to

compensate for the large growth in the labour cost caused by the eight-hour shifts. In these circumstances if the iron trade had continued as it was up to the middle of the present year there would have seemed to be little chance of any general adoption of the eight-hour shift in Cleveland or elsewhere in Great Britain out of the north-western district. If, however, the present improvement in prices should continue for a considerable period, the change may be brought about, and from the point of view of the social reformer that would certainly be in itself a matter for congratulation. At the same time it must be acknowledged that, unless the higher prices should last long enough to allow the shorter hours to effect a general improvement in the quality of blast-furnacemen's work, the next wave of trade depression would be likely to prove more disastrous to ironmasters, and so to blast-furnacemen, if the shifts have been shortened than if they remain as they are.

With regard to the earnings of iron and steel workers in the north-eastern district and generally in Great Britain, it may probably be stated with truth that a considerable section of them make much larger incomes than can be earned except by quite a few exceptional hands in any other industry. This remark applies conspicuously to such men as the leading hands at the rolling mills in steel works, who take the whole responsibility and employ a staff of men, and who in some cases can make over £2 a day, and very often do make above 30s. Their duties in the superintendence of the passage of great slabs and bars of glowing steel backwards and forwards under the massive rollers which are grooved so as to give them the shape required, are very important ; but there is no obvious reason why they should receive more than twice as much as the leading hand at the rolls dealing with wrought iron, who draws what is still the handsome wage of 12s. to 20s. a day. The chief melter at the Siemens-Martin furnaces can make from 15s. to 20s. daily in consideration of the tremendous heat in which his work is done, and of his responsibility in watching the condition of the charge. The "shingler," who amidst showers of sparks adjusts the great balls of white-hot iron fresh from the puddling furnace under the steam-hammer or squeezer, may draw up to 10s. or 12s. a day ; and the "keeper" at the blast-furnace who superintends the flow of the liquid metal from the well of the furnace and prepares the moulds to receive it can reach £3 a week, and often draws over 50s. Beneath this aristocracy of the industry, who must number many hundreds in the Cleveland and adjoining districts alone, comes a large middle class, including the puddlers, and the slaggers, chargers, and barrow-fillers at the blast-furnaces, all making probably between 5s. 6d. and 6s. 6d., and many of the assistants at the processes of steel-making and rolling. Below them comes a class of labourers drawing much poorer wages. A very well informed authority has favoured me with the rough estimate that, in the whole finished iron and steel trade of the north-eastern district, 60 per cent. of the men employed make 25s. a week and upwards, and the remaining 40 per cent. between 17s. and 25s. weekly, of whom perhaps a quarter range between 17s. and 20s. It seems open to serious question whether the extremes of wages thus illustrated—extremes which do not prevail in Germany—can be defended either on equitable or economical principles, and it is satisfactory to know that at a recent arbitration, in which eminent representatives of employers and employed were engaged, an adjustment of wages was effected by which 2s. weekly was added to the pay of the labourers, while at the same time a reduction was made, and loyally accepted, in the case of the very highly paid "head rollers and heaters."

The fact just mentioned affords a fresh proof of the excellence of the working of the arrangements possessed by the iron industry of the north-east of England for the regulation of wages. There, and indeed, as we may hope, over the greater part of the iron districts of this country, the proceeds of that revival of trade which seems happily to have come at last will be distributed without friction and without waste among employers and employed. That fact must enhance the pleasure with which the revival is contemplated by the country at large. There appears to be a widespread, though not universal, anticipation among well-informed people in the iron and steel and allied industries that for a considerable period the increased call for their products will be

maintained. At one and the same time there is a development in the shipbuilding trade, which is still largely a monopoly of this country, and in the demand for railway rolling stock and rails in India, the colonies, especially South Africa, and in South America. The owners of Siemens-Martin furnaces thus profit in two ways, for they provide the steel plates for use in the construction of ships and also—though the increased demand there will not bulk so heavily with them—of a large part of engines and railway carriages and trucks, while the makers of wrought iron, and particularly of "best Yorkshire," are called on to furnish the material for essential portions of those fabrics, and the Bessemer works are requisitioned for steel rails to carry the rolling stock manufactured from the produce of the two other great processes of the trade. The makers of Cleveland pig-iron are specially to be congratulated on the present development of their export trade, which is mainly with Germany, as it probably means in part the recovery of customers whom they lost in favour of Westphalian ironmasters in a spring two or three years ago, when the Rhine was blocked with ice and the German iron and steel manufacturers had to fall back entirely upon the local supplies on which they always largely depend.

All this is most satisfactory. Judging from figures given in the *Labour Gazette* for December, it would appear that adding, as I believe is considered approximately correct, 10 per cent. for the works which do not make returns to the Labour Department, about 87,000 persons are engaged in the manufactured iron and steel trade, and that about 24,000 are working at blast furnaces. There seems to be good reason to believe that the whole of this great industry throughout the country, with the exception of the tinplate manufacture, which employs some 10,500 persons, is participating in the present wave of remunerative activity. Thus we have 100,000 workers or more who, in one way or another, by actual or prospective increases in wages, or by greater experience and assurance of full employment, are benefiting from the present revival in the iron and steel trade, while, when allowance is made for the wives and children of the married men, the direct and indirect benefits of that revival may be estimated as diffused among any number of persons from a quarter to half a million. With them all, and not less with the masters whose resolution and resource have enabled them to battle through the bad times and now to give considerably increased employment, while reaping substantial rewards for themselves, the country as a whole must rejoice. At the same time a hope may be expressed that the return of prosperity will not tempt either masters or men to neglect the uses of adversity. In particular it is most important that the lessons which are embodied in the extremely interesting report of the delegation organized by the British Iron Trade Association to visit the chief iron and steel works of Germany and Belgium last year should be very carefully studied and utilized. It is clear both from the report itself and from the account of the evidence taken and the observations made by the delegates, both employers and operatives, that they were deeply impressed by the excellence of the mechanical arrangements and of the discipline to be witnessed at the works which they visited, the great attention paid to the details of management, and the liberal provision made for technical instruction for youths intended for employment in important positions in the works. The existence, it may be here remarked, of the important engineering departments at the Yorkshire College, Leeds, and at the College of Science at Newcastle-on-Tyne affords evidence that many of the most enlightened members of the iron and steel and allied trades have given practical recognition to the importance of technical instruction. But that recognition is by no means as widely diffused as is to be desired, and the practice observed on the part of some German firms of maintaining youths at technical colleges with a view to their subsequent employment at works is, I imagine, hardly known here. Whether in that direction or on other lines there can be no doubt that our ironmasters and iron and steel manufacturers may gain much from reflection on the knowledge now available to them as to the ways of those who are their chief competitors, and that if that knowledge is turned to full account the British iron and steel industry will be better assured of holding its own through the trade vicissitudes of the future.

IV.

SHIPBUILDING AND MARINE ENGINEERING ON THE NORTH-EAST COAST.

IN another article of the present series I hope to show how closely dependent the manufacturing industries of the rest of the world have been and are upon the mechanical and engineering enterprise of this country, and especially that of Yorkshire and Lancashire. A part hardly less essential is played by the shipbuilding enterprise of the north-east coast in relation to the maritime intercourse of the different parts of the globe. It is difficult to obtain exact figures as to the amount of shipbuilding done in other countries. It is not inconsiderable, and it is growing. But it would probably be well within the mark to say that last year considerably more than 4-5ths of the tonnage of new shipping turned out was the produce of British shipyards. And of that large proportion a full half was provided by the builders seated on the north-east coast, a district embracing the rivers Tyne, Wear, and Tees, and the port of West Hartlepool. This is not surprising. The presence of great steelworks and an excellent railway system and the proximity of the sea render it easy to bring together all the materials required for modern shipbuilding on the edge of tidal waters. Immense sums and great ingenuity have been expended on making those waters navigable for ships of large burden, and with wonderful success. Close to the great Elswick shipyard above Newcastle the flood tide runs with 24 ft. of water at a point in the Tyne where 30 years ago there was an island. Results hardly less remarkable have been achieved on the Tees; and at all the chief ports in the north-eastern district conservancy and harbour commissioners have pursued a far-seeing and energetic policy in the provision of dock accommodation.

In the district possessing this combination of natural advantages, developed by local enterprise, no fewer than 313 vessels of various kinds were built last year. Its yards build for service of every kind and in every sea—from the first-class battleship and ocean liner down to the steam-trawler. And side by side with its yards, sometimes under distinct but frequently under the same ownership, are great works devoted to the manufacture of marine engines and boilers suited for every variety of vessel. Thus the district presents an industry, or combination of industries, at once vast in scale and remarkably complete in the character of its products. It is not necessary to enter here in any detail into the complicated and highly technical, though very attractive, subject of marine engines. The processes of their manufacture do not differ in any important respect from those in use in engineering works generally, which will be described with some fulness in another article. The engineers of the north-east coast, it is enough to say, have played a very important part in those developments of the mechanical arts by which the economy and the efficiency of the use of steam power at sea have been so largely increased during the last 20 years. Alike in marine engineering and in shipbuilding, the keenness of the rivalry among the numerous captains of those industries on the north-east coast, as well as between them and other great seats of the same industries, has served as a powerful stimulus to improvement in many directions. Individual firms lavish their best thought and incur large outlay in the more or less successful endeavour to solve problems of interest to every one connected with shipping, directly or indirectly, which is almost as much as to say every dweller in every civilized and semi-civilized country. They do it all for their own profit, but their rivals and the world at large must sooner or later be the gainers, whether the experimenters themselves gain or not. No one can visit the north-east coast at the present time without having this truth impressed upon him. Thus, to take an illustration from marine engineering, a well-known firm at West Hartlepool last year fitted a large ship built in their yard with a five-crank engine, the patent of their engineering managing director. The results are said to have been so satisfactory that the firm of shipowners who took the first vessel thus engined have

ordered another. But the point I am concerned to press is that, whatever the measure of success attending this latest stage in the progress from the simple engine, with single cylinder and crank, of 30 years ago, it must be to the common advantage that the quintuple cylinder and crank arrangement should have been tried. The line of permanent advance in respect of speed, economy of coal, reduction of vibration, and so forth may or may not lie that way; but it must be desirable that we should know whether it is on that or some other line that progress should be sought. So, with regard to certain interesting innovations in ship construction which have been brought into use recently—such as the "turret" cargo steamer, introduced by a shipbuilding firm at Sunderland, and the "trunk" form of construction, introduced almost contemporaneously by another firm at Sunderland and by one at Stockton, also for cargo steamers. In the case of the turret, the lines of the cargo ship, as they are generally known, are considerably altered. The turret is an upper deck, the outer edge of which is considerably within the line of the edge of the main deck. In other words, any one looking over the railing of the turret deck would see immediately below him, not the sea, but a broad margin of deck on the level of the main deck, on which can be stored wood, steel girders, or any cargo which is not liable to damage from the wash of the waves. This margin, called the "harbour deck," is divided from the main deck by the framework supporting the turret deck. That framework has an outward curve at its upper edge. The theory is that the waves, broken first by beating against the edge of the harbour deck, over which they can wash with impunity, are finally beaten back by the curved edge of the turret deck, and that the crew and the rest of the cargo are in an unusual degree exempt from the onset even of the heaviest seas. A considerable number, I believe about 30, vessels of the "turret" type have been built since it was first introduced some four years ago. The "trunk" form of vessel does not differ so obviously to the eye of the ordinary observer from the usual type of cargo ship, but it is claimed for it that the trunk—a structure running continuously fore and aft upon the weather deck throughout the greater part of the vessel—both facilitates the stowage of cargoes in bulk and, with other advantages, affords better protection than usual against the flooding of the decks in heavy weather. It is, of course, no part of my business to hazard any prediction as to the extent to which either of the new types of ships just referred to, or both of them together, will tend to displace those forms in internal and external ship construction with which we are all more or less familiar. But it must be recognized on all hands that perhaps immediately, and certainly in the long run, the maritime intercourse of the world must benefit from these spirited experiments on new lines of naval architecture.

Improvements, again, are constantly being introduced into the mechanical arrangements for moving about the steel plates and frames and other heavy material employed in ship construction, and hoisting them when brought to their proper shapes into the places in which they are wanted. These improvements, while reducing the amount of unskilled labour required in porterage in particular jobs, greatly add to the comfort and security of the men actually engaged. In this connexion one of the most interesting of recent developments is to be seen at a shipbuilding yard at Wallsend-on-Tyne. Except in Government dockyards the work of shipbuilding has hitherto been conducted under the open sky, with the aid of great temporary scaffoldings, rising nearly 100 ft. into the air. The keel is laid first on a long row of blocks, and on each side of it there are constructed, for the whole length of the vessel, by the riveting together of steel plates and angle bars, those tanks for water ballast which are now almost universal. Then one by one there are raised into position the great steel angle bars called frames, which form as it were the ribs of the ship, and which run from the side plates of the ballast tanks, through which they are riveted, right up to the edge of the upper deck, in all ships of ordinary construction. They form the framework, to which the outer or shell plates are attached, while on the inside they form the fundamental support for all the beams by which the vessel is strengthened longitudinally and the various decks are supported. Each of the frames, of course, has to be supported externally until the ship is launched; this is done by shoring attached to the scaffolding, which also serves to provide working places

for the men engaged in the work of erection, particularly in riveting the plates to the angle bars and to one another, and in caulking, which, in the case of steel vessels, means hammering up the edges of steel plates, so as to make water-tight joints. As will be readily understood, these immense scaffoldings and the shorings attached to them form a very serious item in the outlay of every shipbuilder, and it is a very trying circumstance that, when the expense of them has been incurred, there are almost invariably a certain number of days on which bad weather—heavy rain, snow, or severe frost—makes the prosecution of outdoor work impossible. It is probable that from 15 to 20 per cent. of working days are on the average annually lost in this way. The Wallsend firm to which I refer have grappled with this difficulty by erecting on either side of two of their berths permanent scaffoldings of steel, consisting of upright standards nearly 100 ft. high, with connecting lattice-work, which they intend to cover on the outside and at the top with glass. The standards are so strong as to be able to support most of the shores required for bearing up the frames of the largest vessels, while their lightness and that of the connecting lattice-work allows of rectangular spaces between the standards amply large enough for the free play of very powerful electric cranes which deal with the heavy materials brought to the berth, and both raise them to the desired height and adjust them in their place within or without the vessel under construction. Apparently these structures, when covered in, will provide for the prosecution of the work of ship construction without any interruption from the weather, and under the most favourable conditions as regards mechanical aids to labour. Here, again, of course, I pretend to no knowledge as to probable economical results. The initial cost of the miniature industrial crystal palaces at Wallsend must certainly be heavy, and different opinions may be held as to the chances that that cost will be fully or more than fully recouped by the security which they will afford against all interruption to the work of shipbuilding, and by the attractions which they may offer to the most industrious workmen. But it is at least certain that the whole body of the shipbuilding industry, both employers and employed, have reason to be obliged to the firm who are undertaking the very interesting experiment just described.

The examples of enlightened enterprise to which attention has been called are but specially prominent exhibitions of a spirit of progress widely present in the shipbuilding and marine engineering trades of the north-east coast. It has also been effectively shown in the important provision for technical instruction in naval architecture and marine engineering, and for engineering experiments, which many of the leading firms of the district have combined to make at the " Durham College of Science " at Newcastle. This spirit of progress, it should be understood, has not only survived, but been developed by periods of great fluctuations in prosperity, fluctuations tending, moreover, towards a distinctly lower scale of profits. Times were when the offices of the leading shipyards were beset by eager shipowners, ready to give any prices that a sense of decency or prudence would allow the builders to name. But those times are not now. It is doubtful whether even in 1889-91, when the output reached and maintained unusually high figures, the profits, taking into account the substantial and successive rises in wages secured by the workmen, approached the standard which they held in more distant years. The legitimate demand for shipping was more than overtaken, and then followed a period during which production fell off and prices were low. Last year, undoubtedly, there was a great spurt in ship-building, occasioned mainly by the " boom " in freights, which was so marked a feature of the late autumn months. The " boom " was due to several causes, chief among which may be reckoned the expectation that the impending scarcity in India would necessitate the importation of large amounts of grain by sea, the considerable imports of grain which were actually made to supply a deficiency in the Australian harvests of last year, and the anxiety of Russian corn producers to get their grain away in good time before the Eastern question should lead to hostilities. The returns of shipowning jumped up ; it was thought—on what grounds does not clearly appear—that they would remain up, and orders accordingly poured in upon the shipbuilders. But the new demand did not lead to any such elevation in prices as occurred in 1889-91, to say nothing of

earlier good times. And, as regards profits, there is good reason to believe that they have been far indeed from rising even for a brief interval to the inflated level of the earlier decades. Eminent shipbuilders at different ports on the north-east coast have mentioned individual facts and figures to me with regard to vessels recently turned out by them which illustrate the contrast in a striking manner. Contracts at considerably enhanced rates were, no doubt, obtained in many cases, and the general range of prices was raised, but to no small degree those enhancements were consumed by the increases which were given in wages in the course of last year. The immediate outlook for the shipbuilding trade is not as bright as could be wished. There is, indeed, at the present time, plenty of evidence of activity in the shipyards, but they are largely occupied with the fulfilment of orders received during the "boom" in freights, and sadly few have been received during the last few weeks. The "boom" died away even sooner than might have been expected, and there seems to be no reason to anticipate any such revival in the rates for sea carriage as would create a large and steady demand for new commercial ships of any kind. As to warships, something may be said in an ensuing article. The prosperity of the marine engineering industry is naturally bound up with that of shipbuilding, and in the absence of any marked change in the generally received type of marine engines, such as led to the turning out of the "compound" or double in favour of "triple-expansion" engines some ten years ago, its prospects of activity must vary pretty closely with those of a demand for new ships.

Of the persons employed in the shipbuilding yards of the north-east coast, whose numbers—men and boys—must add up to considerably over 20,000, the skilled artisans are about half. Of them, again, about half or more belong to the class known locally as the "black squad," and are for the most part members of the great Boilermakers' and Iron Shipbuilders' Society, which has its headquarters at Newcastle, in substantial and well-built offices, where dwells its well-known and much-respected general secretary, Mr. R. Knight. There is no trade unionist in the United Kingdom who has done more than Mr. Knight to secure favourable terms of remuneration for those on whose behalf he acts. The time wage of the iron shipbuilders for building is 36s. 6d., and in repairing shops 42s. a week, but there is probably not a member of the trade in the north-eastern shipyards who does not make more than the latter amount, and the great majority make a good deal more. For, unlike the bulk of trade unions, the Boilermakers' and Iron Shipbuilders' Society encourages piecework, and the changes in wages which it seeks at favourable times are enhancements of piecework rates. I believe that it is well within the mark to say that 10s. a day is a very common and, indeed, would be considered a low wage for the iron shipbuilders, while large numbers of them make from 16s. to 20s. a day, and not a few first-class workmen earn £8 weekly and more. The work thus handsomely remunerated is, no doubt, of very great importance. It includes the "bending" of the great angle-bars which, as has been mentioned, form the "frames" or "ribs" of the ship's side. This is done by drawing and hammering the steel when hot from the furnace against pegs inserted in holes on an iron floor along chalk lines which have been drawn there to indicate the exact curve to be taken by the frame. When it is remembered that these frames are often 60 ft. to 80 ft. long, that quite different curves have to be taken at different parts of that length, and that the desired shape must be taken by the metal before it cools, it will be readily understood that the operation of "frame-bending" is one requiring great skill and judgment. Other important duties discharged by members of the "black squad" are the shaping of the steel plates, the marking of the places on the plates and frames where holes must be punched or drilled for rivets, the actual riveting of the different parts together, and the "caulking" already alluded to. Riveting in particular is very arduous work, and I am told that it is a rare thing to see a gray-headed man engaged at it. The high wages earned by the "black squad" appear to be very readily paid by their employers, whose attitude towards Mr. Knight is one of very cordial respect. He has known when to apply, and how to apply, for improvements in the piecework rates; he has known equally when not to apply for such improvements and when to acquiesce in reductions; and, what is not less important,

he and his council have known how to secure in almost all cases the loyal fulfilment by the members of their society of the obligations undertaken by them. The excellent relations happily prevailing between the iron shipbuilders and their employers are both illustrated and strengthened by an agreement under which no change in wages shall amount to more than 5 per cent. up or down, and any change, when made, shall hold good for six months at least. This agreement has still some two years to run, and is giving so much satisfaction on both sides that there is good reason to anticipate that it will be renewed.

The large earnings of the iron shipbuilders radiate even upon the unskilled or less skilled labour associated with them. Thus the iron shipbuilders platers' "helpers," a numerous class, of whom, for example, there are 170 adults in a yard employing altogether about 1,100 hands, draw from 28s. to 31s. weekly when at work. I am afraid it cannot be said that this fact induces fraternal feeling between the platers on the one hand and the less skilled workmen on the other. Each side complains of losses suffered by the want of reasonable consideration shown by the other in staying away from work without due notice. And this, unfortunately, is only an illustration of a state of things which is peculiarly characteristic of the shipbuilding industry. It embraces many trades, among which, besides the iron shipbuilders, may be mentioned the drillers, the shipwrights, the joiners, and the engineers (including blacksmiths and fitters), as well as many miscellaneous workmen. Very bitter contentions have arisen in recent years between unions representing different sets of the workmen just mentioned as to the proper "demarcation" of their respective spheres of labour. The shipwrights, for example, claim, and with historical justice, to be the representatives of the builders of the wooden walls of old England. In Government dockyards men who were apprenticed as shipwrights are engaged in the construction of the fabric of ships, even though steel has taken the place of wood. But everywhere else that great function has passed into the hands of the "boilermakers and iron shipbuilders," and the shipwrights or carpenters have been relegated to that work in wood for which their early training specially qualified them. This displacement has, naturally enough, excited a good deal of sympathy for the shipwrights. It has also, not less naturally, made them very keen to resist any encroachments upon the wooden domain left to them, and in this connexion there have been frequent and hot disputes between them and the joiners. Broadly speaking, the distinction between carpenters and joiners, in shipbuilding as elsewhere, would seem to be marked by the line between structure and furniture; but ships lend themselves in a rather special degree to difference of opinion as to the exact whereabouts of that line. Disputes on that subject, disputes between drillers and caulkers on the claim to finish a certain kind of bolt mainly used in warships, disputes between fitters and plumbers as to the right to lay iron piping in ships, have been fertile sources of delay and disorganization of shipyard work. The contending parties in these disputes are not willing to let the employers settle them, and they have not always accepted with readiness and promptitude the decisions of joint boards or of arbitrators appointed for the occasion. It is not altogether surprising that they feel as strongly as they do. The individual grounds of dispute in many cases may seem trifling and even ludicrous, but, after all, defeat must mean the probable loss of bread and butter to some workmen's households. Yet extensive interruptions of work and hindrances to the fulfilment of contracts, such as disputes of this kind have often caused, are more than the industry, as a whole, can well afford to bear, and it is of the greatest importance that machinery for the rapid and pacific settlement of "demarcation" questions should be generally adopted and supported by all the authority of the trade unions. Real progress has happily been made, but a great deal remains to be done. In regard to the wages of other classes than the iron shipbuilders it may be mentioned that the blacksmiths and the drillers earn on piecework about 11s. and 7s. a day respectively, while the majority of the carpenters, joiners and fitters are rated on time at about 39s., 38s., and 35s. a week. For the most part the relations between the shipbuilding employers and their workmen have through several years of varying trade been favourable, advances and reductions being generally arranged by friendly meetings of representative masters and men.

V.

ENGINEERING IN YORKSHIRE AND LANCASHIRE

IN the north-east corner of England, to which special reference was made in two preceding articles, one of the facts most forcibly impressed on the observant visitor is, as has been said, the almost exclusive predominance of industries of which the material is mineral. When we pass to the West Riding of Yorkshire and the adjoining county of Lancashire we are at once presented with a different arrangement of the industrial fabric. In some places indeed—notably Sheffield (with which it is proposed to deal in a subsequent article) at one end and Furness at the other end of the great industrial territory in question—the field is practically monopolized by trades connected with the treatment of iron and steel and other metallic substances. But for the most part, the great engineering and machine-making industries of Lancashire and the West Riding are carried on in close proximity to the manufacture of cotton and woollens. This combination, or rather interlacing, of industries has many important bearings upon the conditions of the average skilled workman's household, and to these some reference must be made at a later date. For the moment it is interesting to consider these seats of vastly-varied production from the consumer's point of view. Could it be supposed that by some mighty ebullition of unsuspected volcanic forces the valleys of the Irwell and of the Aire, whose pollution was so grimly immortalized by Kingsley, were to be involved in ruin as complete as that which overwhelmed the pink and white terraces in New Zealand, the tragedy of it would, no doubt, excite widespread horror and numerous subscriptions. But besides all the sympathy, effective or otherwise, which such an event would call forth, it would be felt in the most direct and practical manner through every department and grade of human civilization. The present article is not the place in which to dwell on the many-sided ramifications of a disaster which would at once cripple, if not paralyze, the fashionable dressmaker of Paris and New York and dry up the supply of decorative decencies to the natives of the various *Hinterlands* of Western Africa. But wherever the industrial arts most flourish or are struggling with the greatest vigour to establish themselves, there it is not too much to say that the odds are 100 to 1 that you will find the best workers of the old and the new world obtaining all or much of the best of their mechanical equipment from Lancashire or the West Riding. One of the most unmistakable symptoms of material progress, as well as one of the surest means of advancing it, is facility of locomotion, and there are few regions on the frontiers of civilization to which a Leeds or Manchester man can travel without finding locomotive engines stamped with names which are to him as household words. Take any of the tropical or sub-tropical territories of Asia or Africa within which British officers, or merchants, or planters are extending the effective range of England's civilizing mission, and there will be found products of the forges and foundries of South Lancashire and West Yorkshire. For several years past these locomotives have been steaming within sight of the Straits of Malacca. By their strength the inevitable cruelties of the long porterage to Uganda will be abolished, and the now isolated British representative there will be brought into easy touch with the Empire as a whole and the Foreign Office in particular. They snort defiance to the tsetse fly, and will soon place Fort Salisbury and Rhodesia in direct steam communication with London. Their services are requisitioned for the working of railway extensions in many parts of India. They are summoned by the popular Australian Governments to give their vital help to the effective utilization of the colonial lands, a Manchester firm, for example, having been conspicuously associated of late years with the provision of engines capable of wrestling easily with the severe gradients of the New South Wales main lines. From the same English districts come

all or many of the locomotives used on railways and street tramways by the most active and progressive of the South American States. Passing again to Africa, the same thing holds of the locomotives ordered for the Dongola Railway. While one Leeds firm is making or has made engines, one of whose terminal stations will be at Lake Victoria, and which will steam thence to the Indian Ocean, another was commissioned to provide the engines needed to annihilate the dangerous spaces between Upper Egypt and the oasis which was the outlying northern stronghold of the Mahdi.

It may not be uninteresting to give a few particulars as to the labour employed on the tank engines made for the Dongola Railway. Time being, of course, an important element in regard to the expedition, it was well that the line laid was a light one and only called for locomotives of a much smaller size than those in use on our railways. Even so, however, the total time—eight weeks and four days—which elapsed from the receipt of the order by the firm in question to the trial under steam of the first two of six locomotives ordered, was remarkably short. In a future article the general character of the chief processes in use at Engineering works will be considered. Here it is enough to say that the materials of which locomotives are built up comprise castings and forgings, and that the preparation of these materials goes on contemporaneously. The castings result from the cooling of molten iron or steel poured into moulds of sand. The metal thus treated takes various, sometimes complicated, shapes, and will bear ordinary strains. The moulds are prepared from patterns of wood. In the case in question it was possible to use a number of existing patterns with slight alterations, but many new ones had to be made, and four " pattern-makers " were employed for four weeks. In the preparation of the numerous moulds or casting-beds required, and in the charging of them with molten metal, about 20 moulders were employed for about five weeks. During about three weeks of the same period seven smiths and nine strikers were engaged upon the forging of various parts of the mechanism of the engine. These are prepared by hammering, cutting, and welding the metal—steel or wrought iron—when hot from the furnace. The resulting parts are more or less simple in shape, and will endure severe and varying strains. About 50 " fitters " and machine-men were engaged for five weeks in bringing the various castings and forgings, by the aid of hand and machine tools, into exact correspondence with the design in all its details. Their work began at the end of the third week from the receipt of the order for the engines. Twenty artisans of another class, the boiler-makers, worked for six weeks in another department of the establishment concerned to give life to the whole mechanism by constructing the boilers and their auxiliaries, such as the tanks and coal boxes. The work of putting together the different parts of the engines occupied 20 " erectors " for four weeks, some parts being put together while others were being finished. Twelve painters exercised their calling for three weeks upon different parts of the engines and the completed structures. Throughout the construction, it will be understood, every workman was working either with immediate reference to detailed drawings furnished by the draughtsmen of the establishment or under the direction of those who had such drawings before them. The drawing office is the brain of the whole great engineering organism. Counting draughtsmen, it would appear that at various times about 150 persons were detailed for the production of the first two engines sent out to Dongola.

The actual number of persons employed upon any individual engine must, of course, depend upon its size and the speed with which its completion is required, and the proportions as between the different parts of the work may also vary considerably; but the figures given above will serve as an indication to the ordinary reader of the general division of labour in the production of a locomotive. Clearly, all the workmen and their employers engaged in the production of locomotives for Northern, Equatorial, or Southern Africa are just as truly participators in the rescue of the Dark Continent from barbarism as any of the officers, soldiers, or private adventurers who have been working or fighting on the spot. A similar and not less intimate collaboration obtains between the great

English engineers and their artisans and the leaders of industrial progress in foreign countries where civilization is of more or less ancient date. Not only in new countries, such as Queensland and Fiji, or again in the Philippines and Mozambique, but in many parts of Europe, especially where beet-sugar is being extensively cultivated, the steam ploughs for which a Leeds house is celebrated may be seen cutting their deep and searching furrows. In the forges of several of the most elaborately equipped ironworks of the Continent of Europe and the United States some of the most important plant, such as hydraulic presses of enormous power, bringing to bear a pressure of several thousands of tons, and doing with more evenness and certainty the work of the steam hammer, will be found stamped with a well-known Manchester or Leeds name. And from Lancashire and the West Riding locomotives and many of the principal machine tools and testing machines required are sent out to meet the needs of the important iron and steel industry which is springing up in the South of Russia and in Northern Spain and in Japan. These are but a few illustrations of the calm confidence with which the engineers of Yorkshire and Lancashire have provided and are at any moment ready to provide for the requirements of those who it might be thought would thus be helped to develop into more or less formidable competitors of their own. To a very considerable extent that possibility has been realized. Whereas formerly the whole supply of locomotives for the European railways used to come from this country, the needs of those railways are now, in the main, locally met, and the foreign makers—nursed, as no doubt they have been and are, by the high protective tariffs in their own countries—are able to dispute the command of neutral markets with our great locomotive builders. Other causes than those of simple economic competition have, doubtless, been at work to restrict the number of British-built locomotive engines taken to serve the rapidly extending railway system of Russia ; but Lancashire and Yorkshire would have had, and would now have, more orders from that quarter had not France and Germany been able and anxious to supply the needs of the Russian railways, and were not the productive capacity of the Russian engineering shops steadily increasing.

And if the great engineers of our northern counties have thus serenely assisted to establish the position of those foreign manufacturers, who, as time goes on, become able to meet them first in their own and afterwards in neutral markets, no surprise can be felt at the extent to which they have gone and are going in building up textile industries offering most inconvenient rivalry to the yarns and piece goods of Manchester, Leeds, Bradford, and the great network of spinning and weaving communities in Lancashire and West Yorkshire. Fifty years ago the textile manufactures of Europe and the United States were in their infancy, and those of Asia, excepting, of course, the beautiful old hand products, were not born. Then England spun and wove, and prepared the manufactured fabrics for the clothing of the world. Now there is hardly a country of Europe in which the needs of the masses of the people in regard to clothing are not mainly satisfied by native factories. It is the engineers of Yorkshire and Lancashire who have enabled and are enabling all those countries to make and maintain this great industrial advance—an advance quite necessary in the interest not only of the material convenience of their inhabitants, but of that variety of occupation which is essential to intellectual progress in a nation. It is our engineers who first provided the foreign factories with their equipment for spinning and weaving, for bleaching, and calico printing, and when doing so provided also highly-skilled foremen qualified to give the requisite guidance and instruction to the native workpeople. Nor are these great services to the human race to be by any means entirely credited to two or three large industrial centres like Manchester and Leeds, singularly comprehensive as is the engineering production of those cities. Just as in parts of the West Riding almost every little town develops some particular branch of the woollen trade, and every town has some engineering firm supplying its local requirements, so engineering industries doing special work for other markets appear to find or collect specially suitable workmen in limited districts of Lancashire and Yorkshire. Thus Oldham, Bolton, and other towns within a 30-miles radius of Manchester, supply not only the machines, but the steam engines for a large portion of the world's textile needs.

Keighley, in upper Airedale, has a special reputation for the production of machine tools; Otley, in Wharfedale, for printing machinery, and so on. This specialization of local aptitudes is a very interesting circumstance, and would seem not unlikely to react in a sense favourable to the persistence of local types of character.

To resume, it is still to a very large extent the engineers of Yorkshire and Lancashire who replace the various machines used in the production of clothing by the foreign manufacturers whom they have set on their feet. There are countries—and Russia, it is interesting to note, is one—in which already native enterprise is, or, at any rate, thinks itself, equal to supplying the heavier and simpler parts of some textile, bleaching and dyeing machinery, and from which, therefore, the demand upon the North of England tends somewhat to restrict itself to the finer, so to say, the more intellectual, portion of the mechanism. This tendency will doubtless increase, and, as successive generations grow up in an atmosphere of thought bearing on mechanical questions, it is probable that one country after another will become more self-contained in the matter of machine construction. In a subsequent article something may be said on the question whether British mechanical engineers can reasonably hope to retain something like their present ascendency, and if so by what means, concurrently with the growth to full maturity of the metallic as well as textile industries which they have nursed into vigorous adolescence.

To-day it is sufficient to note two things—first, that in the supply of equipment for the spinners, weavers, bleachers, dyers, and cloth printers of our own Empire, especially those of India and the Australasian colonies, and in the establishment of the rapidly-growing industrial life of Japan, an immense field lies open to and is already partially occupied by British engineers, outside the great Continental and home markets for their products; secondly, in the construction of machinery for the employment of electrical energy, there is, both abroad and at home, a practically limitless sphere for the application of British resources alike in capital and in inventive and adaptive ingenuity. It is strange that the home demand for such utilizations of the finest flower of later 19th-century scientific mechanical discovery has hitherto lagged far behind the demand which has come from countries of which England has always assumed to hold a great industrial lead. While the inhabitants of all except a few favoured spots in the metropolis and the leading provincial towns of this country still live and move at night in darkness made visible and air corrupted by coal gas, there are many second and third rate towns on the Continent and in the United States which for years have had excellent installations and rejoiced in the strong and cool radiance of the new illuminant. And not only with regard to lighting, but in respect of its use for locomotive purposes and for the working of machinery, England, in her effective desire, is a third or more of a generation behind some of the Continental nations. Naturally this singular apathy, largely explicable no doubt by the cheapness of gas and steam coal in this country, has checked the development of manufacturing activity here in the direction of electrical appliances. English engineers, however, have not waited for the development of an English demand, but have taken steps to obtain at least their share in the satisfaction of that which has grown up abroad both for the illuminating and the motor uses of electricity. In Manchester first, and subsequently in Leeds and Newcastle-on-Tyne, works of first-class importance have devoted special departments to the construction of dynamos and motors and of steam-engines for driving the former. An extensive trade is done in these products with Russia, where, for example, numerous mills and calico-printing works have been supplied for years with electrical installations, both for lighting purposes and, in some degree, for the transmission of power. In Sweden an electric railway has been equipped from Manchester, and even in Germany, notwithstanding the fact that her mechanical engineers have paid special attention to the subject, a great firm from the same city has lately succeeded in obtaining a contract for an important installation for the application of electricity, under the recently discovered and very striking process known as electrolysis, to the manufacture of chemicals.

These examples show what can be done in the direction of electrical engineering by British enterprise and energy even under what may fairly be considered depressing and disadvantageous circumstances. There are many encouraging indications of a growing appreciation of the advantages of electricity as a motor agent among great manufacturers in this country. A leading calico-printing house in the Manchester district has recently secured a complete electric equipment, providing them with light throughout their works and with a small electric motor to work each printing machine. An electric cable works is being fitted up with a score or so of 8-horse power motors. An important engineering works at Sheffield is about to introduce electric motors for the working of a large machine-tool shop. In some important collieries electricity has been introduced for the transmission of power as well as for lighting. Such examples as these—and many more might be cited—are sure to exercise an important influence, and it may reasonbly be expected that the end of the century will witness an extensive growth of the employment given to English electrical engineers by manufacturers of various kinds at home, as well as by private lighting companies and municipalities. If so, the engineering industry of Yorkshire and Lancashire may come to exercise a share in promoting the utilization of electricity for the benefit of mankind, not unworthy of those who, and their fathers before them, have wielded the mighty influence already indicated in the advance of other industrial arts throughout the world.

VI.

ENGINEERING IN YORKSHIRE AND LANCASHIRE

TO attempt within the space permissible to such articles as those of the present series anything approaching to a comprehensive survey of the field of industrial construction occupied by the mechanical engineers of this country, or of Lancashire and the West Riding in particular, would be not only futile, but ludicrous. All that can be reasonably aimed at, by the present writer, at any rate, is the indication of a few leading points in such fashion as to assist the non-engineering reader to form for himself a picture of the broad features of life in this vast and varied industry. Such broad features there are, constituting an essential unity amid an almost infinite diversity. The materials dealt with are the same—pig iron, wrought iron, and steel, in varying proportions, and, in limited quantities, copper and zinc; and the processes, though of the greatest possible variety in scale, can all be summed up under a very few heads.

Every part of every product of every engineering works has been either cast or forged or smithed into some more or less close resemblance to the shape it is to assume in the completed product, and subsequently reduced to exact correspondence with the design by the action of machine tools and tools worked by hand. The foundry is the scene of the casting, the forge or smithy of the operations which their names imply. But before the founders or the smiths can get to work the whole scheme of the engine or machine to be produced has to be thought out in every detail, and the thought has to be expressed in graphic form in the drawing-office. The dimensions of that department vary greatly from works to works in accordance with the degree in which their owners apply themselves to the production, on the one hand, of individual engines or machine tools designed to do special work, or work of an ordinary character under special conditions, or, on the other hand, of machines which do practically the same work under the same conditions wherever they are sent. Thus it is quite possible that in works employing only a few hundred hands, but turning out products of many types and varying those types to meet the various needs of many individual customers, the drawing office may be quite as large as that to be found in works whose hands are numbered by the thousand, but which are principally employed in the production and reproduction of a few clearly-defined classes of machines. In the latter, however, as truly as in the former, the drawing office is the governing intellectual principal of the whole, the centre to which all the other branches of the undertaking look for the direction of all they do. Every engine and machine—at any rate, every one that sells—embodies the complete or partial solution of a complex problem—more generally of a group or series of connected problems—in mathematics, dynamics, heat, and chemistry, and it may be in other sciences besides, especially, of course, in a large and growing new department, that of electricity. Only a few, indeed, of those who in the past and present ages have done most to advance the engineering arts have been perfect masters of all the sciences whose laws govern the realm in which they were moving. But, none the less, has the close observance of those laws, even if sometimes very partially understood, been always necessary to any degree of mechanical success, and the success secured has been in exact proportion to the closeness of the observance of laws. Similarly, though but few of the workmen in any of the departments of a great engineering establishment have more than a rule-of-thumb acquaintance with the nature of the problems with which the work in their hand is concerned, they are able by closely following the designs given them from the drawing office, and only so, to contribute in their measure to the solution of that problem.

Let us look first at the case of the foundry, which is responsible for the production of many of the largest and of the smallest portions of almost all engines and machines. Here the metal-worker is, so to say, at one remove from the drawing office. For his benefit the drawings are translated into wooden models by the pattern-maker, whose occupation—though he is an essential feature of all engineering works, and commonly belongs to the Amalgamated Engineers' Union—is to all intents and purposes an attractive branch of high-class carpentering. His " shop " is bound to be well lighted, and is charged with the pleasant savour which always surrounds woodworkers. In it you may see, according to the branch or branches of engineering to which the owner devotes himself, models of almost all conveniently and satisfactorily castable things, from a small detail of the delicate machinery of spinning up to the chimney, cylinder, and wheels—not the tyres—of locomotives, and the massive framework of steam hammers and hydraulic presses. Thence the model or pattern goes to the foundry, an apartment of large, sometimes of vast, proportions. There, in tall furnaces, denominated cupolas, very similar in construction to the blast furnaces described in a previous article, pig-iron is reduced to a molten condition in quantities suitable to the needs of the foundry, and drawn off as required.

With his wooden model from the patternmaker's shop the ironfounder, or " moulder," prepares in sand his mould to receive the molten metal. This he does either in a rectangular box, in the case of small castings, or on the sandy floor of the foundry when there is a large mass of metal to be dealt with. It is an interesting operation, requiring no small degree of judgment and deftness of hand. The latter natural or acquired characteristic is needed especially for the removal of the pattern, after the impression has been accurately taken in the sand, without disturbing more than is absolutely necessary any of the angles or edges, for the careful readjustment of any breaks caused by that withdrawal, and also for making of the right size and shape the " gates " in the sand through which the molten metal is to be poured, and the " vent " through which the air in the mould may escape. Without this latter precaution, not only would the delicate fabric of the mould be destroyed and the casting come to nothing, but an explosion dangerous to life might ensue. The position of the " gates," or " runners," is a matter as to which good judgment is very important, both with reference to the filling up of any portion of the casting where shrinkage is specially liable to occur in cooling, and also in regard to the facilitation of the function of the vent-holes. All the interior surfaces of the mould, it should be said, are dusted over with a blackening of oak charcoal, which, taking fire on the inrush of the molten metal, tends to reduce the adhesion of the sand to the casting. But, even so, it is of moment that the inlets for the metal should be so placed and constructed as to minimize the shock to the more delicate points in the mould, and therein the virtues of the good moulder find exercise. The mould being ready, the operation of casting itself may proceed. In the foundries of works which are principally occupied in the production of textile machinery, and in which hundreds of small separate castings are required for every individual machine, there is probably hardly an hour of any working day when the visitor will not find the moulders busy drawing off the molten iron from the cupola into ladles holding a few gallons apiece and pouring it thence into box after box full of individual moulds. In such cases, by the way, it may be remarked, the same features in construction recurring again and again, mechanical moulders of an ingenious character have been introduced, and the patterns used are of metal and not of wood. The running of the molten metal into these numerous small moulds is a very interesting process. As the recesses of each mould are filled up with the fervent liquid, tne air, escaping through the " vents," shoots out in tongues of blue fire, the flash of which, from many points of the floor, fringing the ruddy glow of the molten metal under the sand where it is taking its due shapes, creates a scene of singular fascination alike to the intellect and to the imagination. Even more impressive, however, is the foundry of a great engineering establishment at the hours—perhaps once or twice in a working day—when the great castings take place, particularly if one's visit is paid towards

dusk on a winter's afternoon. Then that thought of the yoking of the great forces of Nature in subordinate alliance with industrial man, to which reference was made more than once in earlier articles, presents itself again with fresh intensity and in an extraordinarily picturesque setting. The mould in these cases is "struck" in the sand of the foundry floor by the imposition of the wood pattern within the walls of a shallow pit dug for the reception of the casting. The exigencies of the work of the foundry may have necessitated the preparation of the mould at some distance, fifteen to twenty yards or more, from the melting furnace. But that fact presents no difficulty, even though the weight of metal to be used in the casting may amount to from twenty to thirty tons. Half-way up the lofty building a "travelling" crane, worked either by a steam engine and boiler travelling with it, or by a high speed rope, or very possibly by an electric current, moves backwards and forwards and crosswise. It can probably lift and move with ease twice the weight of any single casting which, under the conditions of the foundry, could possibly be attached to it. Its movements are regulated by a man who rides aloft in a small car at its level. At the proper moment he swings the mighty grappling-hook depending from the crane to the mouth of the furnace, where it is attached to the handle of a vast ladle of rivetted iron plates, lined with sand and clay. The door is opened, and from the reservoir of molten metal within there rushes forth a stream of living gold, the light of which flashes in every direction for 100 ft. or more. When the door is closed and the mighty cauldron charged, its sides greatly overtopping the fiery lake which they enclose, a column of red light rises thence to the roof and moves gravely athwart it as the charioteer aloft guides the action of the crane with its colossal burden slowly and surely to the edge of the mould. On its arrival there the leading moulder and his assistants, in co-operation with their ally above, adjust it with the utmost care above the "gates" of the mould, and, slowly tilting it up, let forth the flood of molten metal. Again, as it streams into its appointed place, the ruddy glare illumines the faces and forms of the workmen and spreads far and wide through the great chamber, and then, as the cauldron swings level once more and returns slowly to the neighbourhood of the furnace, the broad shaft of light glides solemnly backward across the roof. The whole process is full of opportunities for the brush of any artist who can catch and convey such momentary visions as would have thrilled the soul of a Rembrandt.

Nor must the artist and lover of the picturesque, any more than the student of industrial life, neglect to visit the much smaller chamber devoted to brass founding. From small furnaces beneath the floor, where the brass—a compound itself of copper and zinc—is melted, there issue evil fumes and blue flames of sulphurous quality, and when the molten metal is poured into the moulds—here almost always of moderate size and arranged in boxes—there rises from the vent holes a weird medley of flames of divers colours—green, blue, orange, red and yellow—for all the world like a study for the stage representation of a Tartarean rainbow.

So much must suffice for the casting processes. The parallel processes of forging or smithing—the latter term being employed when the operations carried on are on a small scale—are going forward at the same time in regard to other portions of the same engine or machine. The differences between the forge or smithy and the foundry are essential. In the latter, as has been seen, the metal, whatever it may be—pig-iron, steel, or brass—is reduced to a fluid condition, in which it takes of itself the forms prepared for it by the moulder. In the former, the metal—wrought-iron or steel—is brought by furnace heat not to a state of fusion but to a pasty condition in which by violent pressure, applied in various ways, it is forced to assume in outline the forms indicated by the drawings furnished to the forge from the drawing-office. The active pressure is always applied from above, either by means of hammers swung by the stout arms of the smiths and their assistants, the "strikers," or by the ponderous blows of steam-hammers, from a few hundredweight up to many tons in falling force, whose strokes, throbbing through the night air of Northern towns, tell the wakeful citizen that business is good enough to require the employment of a double shift of workmen at some of the great engineering

works. Or, again, a pressure equal to, or greater than, that of the blow of the most powerful hammer is brought to bear evenly and without intermission, by mighty hydraulic presses. The degree of downward force varies, of course, with the size of the portion of metal under treatment. It is exerted, for shaping purposes, by such means as bending the white-hot bar against the edge of the anvil, building up desired projections, as in a crankshaft, by welding slabs of incandescent wrought iron to one another, and by pressing the yielding metal into semi-circular or other grooves of a "swage-block," or into a "die" formed for its reception. The realm of this mechanical forging has considerably increased of late years. It includes already articles of such constant use in mechanical construction and otherwise as nuts, bolts, rivets, and horse-shoes, and it may safely be assumed that it will spread further. But for a very long time to come, if not always, the part played by individual workers in a forge must continue to be not only important, but conspicuously interesting. No visitor can fail to observe the promptness, alertness, and accuracy of eye required of the smith in the adjustment of his white-hot bars from the furnace on the anvil, and of layers of such metal of the right size at the right spot when welding is in progress, and, again, in the delivery of blows from his hammer exactly when they are required, to produce the best effect with the least loss of the welding heat which escapes so quickly. It is an old trade, which has never lost its ancient element of romance. And certainly that element is far from having been banished by the introduction of the steam hammer and the hydraulic press. The issue of the vast block of solid fire from the furnace, its passage thence, either on a truck guided by workmen, or with the aid of an overhead travelling crane, to the anvil of the steam hammer; the tremendous impact of the falling block of cold iron upon the glowing mass below, hurling a torrent of sparks in every direction; its adjustment by the long forks of the smiths to receive blow after blow, until it is turned by some mechanical arrangement to present another side to the falling battery, and gradually assumes an approach to the desired shape—all this is calculated to impress any observer with a certain sense of awe for the genius of the man who first saw how to impound and concentrate a portion in itself so mighty, though relatively so trifling, of the inexhaustible ocean of natural energy.

It is surely not an uninteresting reflection that in our northern counties some thousands of men are working every day within the surroundings of the foundry and the forge as I have briefly endeavoured to sketch them. Not the utmost familiarity can ever make work under such conditions altogether prosaic and wanting in stimulus to the imagination. There, at any rate, the workman can have no difficulty in realizing the dignity of labour. When we pass to the departments of the great engineering works occupied by the machinists, the fitters, and the erectors we come upon a new kind of interest, perhaps of a more purely intellectual type. In these departments the castings and the forgings, which come there in the rough, have their ragged edges removed by cutting machines of varying designs and degrees of power; have their cylindrical surfaces turned by lathes on which the work rotates under the blade of the tool, and their flat surfaces "milled" by machines, now coming into increasingly extensive use, in which the tool revolves in contact with the work; have holes "drilled" in them by one type of machine for the reception of the bolts or rivets by which they are to be attached to connected portions of the finished structure, and "bored" by another type of machine at points where intersection of one part with another is to take place. The machines employed for these and many other necessary operations in the same departments are many of them extremely ingenious, and some of them also astonishingly powerful. Thus, in works for the construction of boilers and of bridges and girders and in shipbuilding yards, shears may be seen in operation which will cut through cold steel plates of Siemens or Bessemer quality, 8 ft. long by 2½ in. thick, and will go on making a thousand effective strokes of that description every day for a month without needing to be sharpened. In view of such performances, and of the ease with which travelling cranes swing locomotives about for the convenience of the erectors, the question indeed suggests itself whether in the direction of feats of strength there is great scope for further development in the

mechanical equipment of engineering works. But, however that may be, there is no reason to suppose that any limit can ever be set to the extension of the range within which the genius of mechanical invention will substitute perfect automatic processes for those which were more or less perfectly performed by the hand of man. Within the last five-and-twenty years there has been a steady succession of improvements in the construction of the machine tools used in engineering works, by which their productive power has been greatly increased, concurrently with a relative, if not absolute, reduction in the number of men employed. At the same time the domain of the "fitters" proper, the men who, by the use of files, chisels, and other tools in their hands upon rough castings and forgings, reduce them to a condition in which they can be built up, and continue those finishing operations when necessary while they are being built up, into an effective whole, has been to a considerable extent invaded by the machine hands, whose business is mainly to "set" the work accurately for the machine tools, and to watch their operations. The effects of those changes on the intelligence of the workmen are variously judged by different observers, and a consideration of that important subject and cognate matters must be reserved for a later article. Meanwhile, however, it may be remarked that there is certainly a great deal of the work connected with the machining as well as with the hand-finishing of the various products of our great engineering establishments which is highly interesting, and that the work done in them by the fitters proper and the erectors, who, I believe, are not really different classes of workmen, must grow in interest every year. They play the crowning part in the realization of every mechanical improvement which has taken shape in the minds of the employers, managers, or draughtsmen, and thus, in a very real sense, they are, and must know themselves to be, at least non-commissioned officers and privates in the foremost ranks of the vanguard of the material progress of mankind.

VII.

THE MANUFACTURE OF WARLIKE EQUIPMENT

SUBJECT to vicissitudes caused by changes in the methods of production, such as the displacement of iron by steel, the prosperity of the great majority of the engineering works of the North of England varies with the general state of the world's trade. But there is an important minority of these establishments, including some of the largest in the country, where the returns to capital and the amount of employment given depend in large measure upon quite other conditions. I refer to the works which are extensively devoted to the production of warships, of armour-plate, of artillery, and of ammunition. They are situated principally at Newcastle, Sheffield, Manchester, and Barrow. In this connexion, though occasionally orders for warships are received by other shipbuilding firms, Newcastle means principally the shipyards and the complete ordnance factory of the colossal establishment of Sir W. G. Armstrong and Co. at Elswick, and Messrs. Palmers', at Jarrow, engines for the warships being very largely made by Messrs. R. and W. Hawthorn, Leslie and Co., Messrs. Humphrys, Tennant and Co., and Messrs. John Penn and Sons ; Sheffield means the great houses of Messrs. John Brown and Co., Messrs. Charles Cammell and Co., and Messrs. Vickers and Co. as the chief makers of armour-plate in England, those three houses and Messrs. Firth and Son as manufacturers either of guns in their entirety or of their constituent parts, and those four houses and Messrs. Hadfield as makers of projectiles ; Manchester has meant Sir J. Whitworth and Co., as makers of heavy guns and projectiles, which firm has lately amalgamated with that of Elswick ; and Barrow means the Naval Construction and Armaments Company, whose undertaking is being acquired by Messrs. Vickers. Leeds also must be mentioned as furnishing, through Messrs. Greenwood and Batley, besides a considerable supply of cartridges, a large amount of the special machinery employed at Government arsenals in the manufacture of small arms, while several other houses in the same city permit machine-tools and locomotives for use in those national establishments. It must be understood that none of the firms thus mentioned by any means confine themselves to the production of offensive and defensive armament. Most of them have a large, and some of them an immense, business in other directions, such as the building of merchant vessels, the construction of bridges, the production of large forgings and castings for land and marine engines, the rolling of steel rails, the manufacture of machine-tools, files, springs, and of steel of various qualities for all kinds of purposes. If therefore, a graphic representation of the variation in their prosperity over, say, a decade were desired, it would have to be compounded of curves connected on the one hand with the general state of commerce, and on the other hand with the development of defensive or aggressive policy among the nations of the earth. These developments, it need scarcely be said, take place quite irrespectively of whether trade is good or bad. A war scare may happen in the worst, as in the best, of times, and if it happens it will be certain to bring orders to the war departments of some or all of the houses of which I am now speaking. And if there be, as, on the whole, there appears to be, along with a widely-increased dread of war, a general advance in the standard of equipment for war, esteemed necessary by the civilized and semi-civilized nations, not only of Europe, but of America and the Far East, there is assured to the houses in question, so long as they are efficiently conducted, a steady inflow of business and a corresponding power of giving large employment at good wages.

In this connexion, moreover, it is important to remember that the volume of business is liable to frequent and powerful stimulus from a cause which, though always more or less present, does not operate to nearly so large an extent in other branches of engineering. I allude to the practically constant tendency to the disuse of what has been deemed of the best or at least of very good average quality for the ends in view in favour of new appliances or improved adaptations of old ones. This special tendency in the case of warlike equipment results, obviously and inevitably, from the fact that in that sphere the activity of one set of inventors is incessantly at work in circumventing, directly or indirectly, the work of another set, or even, it may be, of themselves. The conflict between the attack and defence is not only potential, but actual. Sometimes the victory inclines to one side, sometimes to the other, and with each alteration in the fortunes of the contest something on one side or the other which had been considered of the best becomes only second-best or third-best. Thus it is that the first-class battleship of ten years ago may be the second-class battleship of to-day—not because it is getting worn out or anything like it, but because by reason of the thickness, together with the material and method of preparation, of its armour in relation to the strength of its engines it fails to present that combination of resistance to the increasing penetrative power of projectiles from big guns, with speed and "handiness," which in the interval has become possible and has been attained. Thus it is again that the history of artillery during the past 40 years is the history of the incessant, almost feverishly-rapid displacement of arrangements which seemed, when introduced, the most ingenious possible, in one part or another of the construction of guns and ammunition, by arrangements providing still more completely and automatically for the working of those terrific engines with the *minimum* of risk and cost to their possessors and the *maximum* of certain havoc to those against whom they may be directed. An example or two may—with apologies to experts—be given to aid the non-technical and civilian reader in realizing the rapidity and magnitude of these changes. It is only some nine years since all armour-plates on British warships were compound structures of steel and wrought-iron, in the proportion of one to two, slabs of the two metals being welded together, and subsequently rolled to the desired thickness. The steel, as being the harder, was placed outside to receive the impact of the enemy's projectiles. But the foundation and the bulk of defensive armour was still wrought-iron, long after that material had been displaced by steel, as has been pointed out in a previous article, in the manufacture of rails and of plates for shipbuilding, and bridge, boiler, and other constructive purposes. Towards the end of the last decade, however, all-steel armour-plates began, by reason of their combination of strength with relative lightness, to gain favour at the expense of the compound ones. For a good many years, indeed, all-steel armour had been made by the great firm of Schneider, at Creuzot, and used in the French navy, but it was looked upon in this country as too likely to crack. In 1889, however, such satisfactory results had been obtained from experiments with all-steel plates of English make that the British Admiralty began to order armour of the homogeneous material for some battleships; and about four years later the general adoption of a new method for hardening armour on the outside, for which the compound material was not suitable, caused it to be entirely disused. Thus the puddlers' industry suffered one more blow, the puddlers' forge disappearing as one of the agencies in the production of the defences of ships of war.

In the case of the new method of treating armour just referred to, the impulse to progress came from across the Atlantic. An American of the name of Harvey devised, or resuscitated, a process, which is called after him, for producing a peculiar degree of hardness on the face of a steel plate. Like so many important inventions, it is remarkably simple, so much so that to the lay mind it seems surprising that it was not introduced long before. "Case-hardening" as a process for inducing great hardness in the surface of certain steel or iron constituents of engines and machinery has been known so long as to have provided the language with a simile employed, perhaps somewhat loosely, in moral discourses. It consists in the exposure of the metal to be treated, at red heat,

to contact with some highly carbonaceous material, such as leather, bones, horn, &c., with the result that a thin exterior layer of the metal sucks up, as it were, carbon enough to give its particles a high degree of rigid cohesion. "Harveying" a steel armour-plate consists, in the first place, in baking it for some days in immediate contact, on one side, with a layer of charcoal, which is practically pure carbon, in a chamber from which air is excluded. By this means the steel plate, originally containing perhaps only about 0·25 per cent. of carbon, becomes carburized for a thickness of an inch or so up to a percentage of 1·25. The hardening effect of this infusion is very powerfully intensified by the subsequent subjection of the plate, when still hot, to a prolonged elaborate sprinkling with cold water. The ultimate result is a surface of such extraordinary hardness that every machining process connected with the cutting of the plate to the proper size and the setting of it to the desired shape that can possibly be got through before the sprinkling is so disposed of. And, whereas for resisting projectiles from the 6 in. gun the standard thickness of compound plate used to be 10½ in., plates 6 in. thick prove, after Harveying, to have sufficient resisting power. This change obviously meant a very large saving in weight of armour, and, therefore, increase in speed and handiness, with the same defensive efficiency, or a very important increase in the latter element concurrently with the maintenance of the standard formerly reached in respect of the former ones. Or, rather, it would have meant all that if an equally remarkable development in the power of artillery had not been taking place within very much the same period.

If, however, we turn to the offensive side of war equipments, the speed with which inventors rise on stepping-stones provided by their own or their rivals' previous efforts to higher levels of destructive efficiency is absolutely bewildering. In penetrative power and rapidity of firing, in diminution of the shock of recoil, in easy and accurate working of arrangements for bringing the heaviest gun to bear on the desired object, under the least favourable circumstances, and in many other respects, the last ten years of the history of artillery have witnessed not so much a steady forward march as a constant race of progress. The penetrative power of the 12 in. or 49-ton gun of to-day, for example, is greater than that of the 16¼ in. or 111-ton gun of ten years ago. At the same time the rapid development of charmingly ingenious arrangements for absorbing the energy of recoil, by means of pistons working in cylinders filled with viscous liquid has reduced the distance covered by the recoil of the 49-ton gun from a *minimum* of 6 ft. to 2½ ft. Again, the ease with which heavy guns can be trained and elevated so as to bear directly upon the desired object, while making allowance for the effects of wind and of the movement both of the ship from which the shot is to be fired and of its adversary, affords a remarkable illustration of mechanical ingenuity grappling with and overcoming one difficult detail after another. Once more, the introduction and development of quick-firing guns within the last twelve years have produced a wide-reaching transformation in naval armament, which probably has by no means reached its limit. It has been recognized that in them lies the chief security of ships of war against the deadly onset of the torpedo-boat. If one or more of those dangerous foes are seen to be approaching a battleship or cruiser, it is necessary to destroy them before they can get near enough to be able to discharge, with effect, their deadly submarine projectiles. The recognition of this truth has brought about the general adoption of quick-firing arrangements for guns of subordinate magnitude on ships of war, and the same principle is being steadily extended in the case of guns of larger calibre, especially with a view to attacking the more lightly armoured parts of hostile cruisers and battleships. All the newer ships are fitted with new quick-firing guns, and in the older ones large numbers of the guns of older design are being gradually converted into the quick-firing type.

The few illustrations above given might, if space allowed, be indefinitely multiplied. They are, however, enough to enforce what has been said as to the peculiarly constant stimulus given to the war equipment departments of engineering business by the progress of invention. Finality, we may be very sure, has not been reached in any direction, and it is interesting to know that the manufacturers of armour here are engaged upon

experiments which point to the expectation that the thick armour of the battleships of the future will have even greater resisting power than that of which the production has been referred to. That these experiments and the changes they suggest are likely to occasion very considerable expenditure may be reasonably inferred from the fact that the introduction of the Harvey process alone entailed upon the principal manufactures of armour-plate an outlay of over half-a-million sterling. It need hardly be said that the various stages in the progress of artillery have involved in many, if not all, cases very large outlay at the works principally concerned.

In regard to the general aspects of work within the great establishments largely devoted to the production of war equipment, they do not in their broad features differ materially from what is to be witnessed in other engineering houses. In an earlier article of the present series I have endeavoured to place before the readers of *The Times* an intelligible sketch of the principal engineering processes. I need not, therefore, enter now upon any description of the vital parts played by the foundry and the forge in the manufacture of both offensive and defensive war material, although those operations are impressive in the extreme, and are conducted in such establishments as those of which I am speaking with almost every conceivable mechanical aid to and substitute for human labour. There are, however, in the more advanced stages of production, especially of guns, certain operations to which no counterpart exists in other branches of engineering. One striking example of these is the set of processes connected with what is called the building-up of a gun. There is no structure in the world in which so vast a strength has to be provided in so small a space as in the breech of a gun. In the 6 in. gun, for instance, explosive forces are to be suddenly and repeatedly liberated, powerful enough to hurl a projectile weighing 100 lb. with destructive violence for a distance of between two and three miles. That strength is secured by shrinking one tube of forged steel, often called the "breech-piece," upon an inner barrel, also of forged steel, then, winding miles of steel wire round the two, and finally shrinking another tube of forged steel over the whole. The shrinking is done by placing the inner barrel, cold and upright, in a pit formed for the purpose, hoisting the outer tube, by a powerful crane, hot from the furnace where it has been reheated, to the top of the pit, and thus slipping it over the inner barrel, which it clasps tight as it cools. Thus jacketed, the barrel is placed in a lathe, and, one end of a coil of wire having been attached to it, it is rotated and the wire is thus wound on to it as the string is wound on to a cricket-bat handle. The 12 in. gun carries 117 miles of wire. It is a slow operation, and, if there were any urgent demand for many guns, the practice, which until a few years ago was the general one, of shrinking consecutively a third and fourth tube, which of course can be contemporaneously fitted and machined, upon the second tube would have to be pursued. Otherwise, this latter method, though affording great strength, is, for larger guns, giving place to the wire system, chiefly owing to the introduction of modern explosives. Another process, which, though it has been conducted on much the same lines for many years, is none the less of special interest in connexion with the manufacture of guns, is that of rifling the barrel. Very few mechanical contrivances are more attractive in their perfect realization of a complex human intention than the machine which slowly moves one or two cutting teeth from end to end of the interior of a gun barrel, far out of reach of any direct control from the hand of a workman, and forms therein with perfect accuracy those spiral grooves by which the necessary rotation is communicated to the projectile in its flight through the air. When the operation is over, indeed, a cast is always taken of the interior of the barrel in gutta-percha or some similar substance, with a view to the discovery and, if possible, correction of any defect in the rifling. But I believe that as a matter of fact such defects very rarely occur. The machining departments of ordnance factories abound in other not less interesting examples of the fertility of mechanical resource and the extent to which the modern engineering inventor is able to dispense not only with manual, but also with intellectual, processes on the part of the workman. The reduction thus secured in the chances of error is of peculiar importance in the manufacture of artillery and ammunition, both from the point of view of safety and effectiveness and from that of

economy. On the one hand, the minutest variation from absolute accuracy in the fittings of any portion of the elaborate breech mechanism of even a small number of guns might produce effects in some crucial action by land or sea which not even the most brilliant generalship could repair. On the other hand, the expensive character of modern ordnance makes it a very great desideratum that, as far as possible, the various parts of the mechanism of guns of different sizes should be interchangeable. This both reduces their individual cost and secures that the reserve store of fittings for supply to any of the guns of a ship's armament, damaged by use or otherwise in action, should go as far as possible. The largely automatic character of some of the mechanical operations in extensive use in the manufacture of ordnance has made it possible for a considerable amount of that work to be put in the hands of semi-skilled men who have been taught the use of individual machines. In other words, the proportion of engineers who have served a regular apprenticeship in ordnance works such as Elswick is probably less than that usually obtaining in other branches of engineering. On the other hand, I believe that the stimulus to production caused by the extensive use of more or less automatic machinery by only partially-skilled men has resulted in an actual increase in the total number of fully-trained engineers employed at the works in question. It is further worthy of remark that in the construction of warships even the proportion of fully-trained engineers employed is much more considerable than in the building of cargo or passenger vessels. This difference arises, as will be readily understood, from the great number and variety of mechanical appliances, connected mainly with the offensive armament of warships, which have to be fitted into their proper places. There is nothing in ordinary commercial ships corresponding, for example, to the complication of pipes, pumping engines, and hydraulic training engines for the moving about not only of the great guns themselves, but of the massive steel turrets or shields by which they and the officers and men working them are protected, or to the pneumatic machinery for the discharge of torpedoes. And the disposal of all these elaborate apparatus so as to obtain the *maximum* of protection and to afford the *minimum* of inconvenience to the combatant and non-combatant members of the ship's company requires a great deal of skilful handiwork from fully-trained mechanics. The tendency to increased employment of that kind is likely to grow rather than to diminish with the further progress of mechanical invention in connexion with war-like equipment.

VIII.

FINE STEEL, CUTLERY, AND SILVER PLATE AT SHEFFIELD

SHEFFIELD is remarkable for the concentration of its industrial energy upon metal working. But there is the greatest possible variety in the scale of its manufacturing operations and in the character of its products. Reference will be made in a succeeding article to the important part played by great Sheffield houses in regard to the production of warlike equipment, and very conspicuously that of armour-plates for ships of war. That industry, it should be understood, is more or less combined in the same establishments with the production of great forgings and castings for engineering purposes, and with the manufacture of fine steel for cutlery and tools, and of springs, tires, files, and other indispensable adjuncts of civilized life. All these branches of metal manufacture for commercial purposes are prosecuted, without any admixture of the warlike element, in many other houses, and they are all well deserving of careful study. Considerations of space, however, render necessary a rigid restriction of any detailed treatment of Sheffield trades to some such selection as is indicated at the head of the present article.

Something must be said of the production of the expensive qualities of steel used in the manufacture of cutlery and tools. The processes for the manufacture of steel on the great scale for engineering and constructive purposes have already been described. They are to be witnessed in many great establishments in Sheffield, but the special qualities of steel for which Sheffield has a unique reputation are produced by quite other methods and very largely from other material. That material is Swedish wrought iron, specially free from sulphur and phosphorus. In the first instance bars of it are " converted " into what is called blister steel by being sandwiched between layers of charcoal in an air-tight furnace and kept there for a week or more at a temperature of rather over 2,000 deg. Fahrenheit. The bars, after subjection to this process, show a blistered surface, and have largely lost the fibrous structure of wrought iron and become a conglomeration of crystals, intersected by channels of crude iron. In order to make it more homogeneous the blister steel is subjected to one or other of two further processes. It is either cut up into suitable lengths, piled into fagots, reheated in a furnace, and welded by hammering or rolling, when it becomes, according as it has gone through this operation once or twice, " single " or " double shear steel," for manufacture into all kinds of cutting blades, or it is melted in a crucible. The crucibles are not ungraceful vases, commonly from 16 in. to 18 in. high, and are made with great care from different kinds of fire-clays, the clay being trodden out when in a pasty condition by men with bare feet to make sure of the detection and removal of any foreign substances. Even so it seems surprising that they should endure as they do a whole day of the wear they are put to. It consists in being placed in small rectangular coke furnaces, which are sunk in rows beneath the floor of the steel melting house, receiving charges either of blister steel or of wrought iron or puddled steel, with a mixture of such ingredients as spiegel-eisen for the purpose of introducing the requisite amount of carbon, and remaining in the furnace until the charge is thoroughly fused. The crucible is then hauled out by tongs and the fluid steel poured from it into an ingot mould also sunk below the floor, after which the crucible is returned to the furnace and recharged, which is done three or four times in the day. The steel resulting from this operation is what is known as crucible cast steel. It is used to a considerable extent for the manufacture of cutlery, but more extensively for that of tools of various kinds, machine and hand, and also for that of some of the most vital parts of locomotive and other engines, such as slide bars and piston rods. Here it may be observed that, while Sheffield produces few completed engines of any kind, many of her great houses are extensively employed in casting and forging, both from crucible

and from open-hearth steel, various parts of engines which are constructed in other towns. On this interesting division of labour between different industrial centres much might be said, but I must pass to a brief consideration of some of those finished manufactures which are specially concentrated in Sheffield.

And first, cutlery. For 500 years the fame of Sheffield for its manufacture of blades has been established, and with whatever vicissitudes, owing to such circumstances as the powerful competition for a considerable period maintained by Birmingham, it has ever remained chief among the staple trades of the town. There is no part of the world in which hereditary aptitude both for the direction and for the detailed conduct of particular manufacturing processes can be said to have more emphatically declared itself than in regard to the making of blades of all kinds at Sheffield. Among both employers and employed the city must be able to show an altogether unusual number of cases in which the occupation has been hereditary for many generations. Like most other industries, the making of knives was until well into the present century extensively conducted on a virtually domestic basis, and in the Sheffield district, while large factories have, of course, for many years been in operation, there are abundant survivals of the old state of things. There are still to be found in the district both a considerable number of the class called locally " little masters," employing a small number of men in the manufacture of knives in their own small premises, and also many workmen who carry on one or other of the principal operations connected with the production of knives in their own houses, or in closely neighbouring premises, for large or small manufacturers. The principal classes of workmen concerned are the blade-forgers, the grinders, and the putters-together, or makers-up, to whom the term cutler is specially applied. Blade-forging, in the case of spring-knives, is still to a considerable extent carried on in the villages round Sheffield in little workshops, which are practically miniature smithies, adjoining the cottages of the workmen engaged in that branch of the industry. In other cottages hard by the makers-up, I believe, are often to be found in the exercise of their calling. And in the same villages there are still to be seen one or more grinding " wheels "—" wheel " being the name given locally to the building in which several grinders carry on their work by the aid of water-power supplied by the impounding of one or other of the streams which are so plentiful in the hill-country of Hallamshire.

In presence of this very interesting persistence of an industrial system of ancient date, it will be readily understood that industrial conditions and relationships in the cutlery trade of the Sheffield district as a whole vary appreciably in many respects from those which prevail under the factory system in other localities and industries. Speaking broadly, I should say that the Sheffield workmen in the cutlery factories, as well as those who work in or close to their homes, are more independent in regard to the times of their working than is at all usual in other trades with which I am acquainted, but that, on the other hand, their employment is more uncertain and intermittent. They are not reprimanded or dismissed if they do not begin work by a certain hour in the morning or find it convenient to stop before a certain hour in the evening. Their time, as they will tell you, is their own, and so, no doubt, it is, in a sense very congenial to the independent temper of the Northern artisan. But the men's time not being their masters', the masters are not specially concerned to economize it, and one hears stories of loss suffered by the men through the want of consideration shown in this respect by the owners or managers of some houses at which they are employed. Again, the Sheffield workmen in the cutlery trade, until a very few years ago, at any rate, experienced but little either of the interference or of the support of industrial combinations in regard to the terms they made with their employers. Their work is almost entirely piecework, and each man makes his own bargain with his employer as to the price at which he will forge, grind, or make-up so many dozen knives. It is claimed, indeed, on behalf of the trade unions that they have done a good deal within the last dozen years to regulate these bargains, and, as compared with the previously existing state of things, that may be so ; but the testimony I received as to the great variety in the rates of payment given, not only by different

houses, but even by the same houses, for the same classes of work, leads me to believe that labour contracts in the Sheffield cutlery trade still largely escape from external interference. The most effective and useful efforts of the trade unions have been directed to the levelling up of the rates of pay given for superior classes of work in the houses where those rates have been low to the standards obtained in the best-paying houses. They have endeavoured, but with less success, to produce a similar equalization of rates in regard to the poorer classes of work.

It is there that Sheffield cutlery suffers most from foreign competition. There are few, if any, blades in the world like really good ones from Sheffield, and so far as the world thinks first of the quality of the blades it buys it will always come to Sheffield for them, unless Sheffield quality deteriorates. So true is this that foreign producers not very seldom think it worth while to counterfeit the corporate marks of great Sheffield makers and run the risks of exposure and criminal prosecution before Judges of their own country, who, as I am glad to hear, show most honourable impartiality in such cases. In regard to the poorer classes of cutlery, however, the markets of the world are flooded with the products of German and other foreign factories at extremely low prices. In order to maintain competition with these products, not a few Sheffield makers who engage in those branches of trade are, or think themselves, compelled to keep their outlay in wages, as well as in every other element of the cost of production, as low as possible. And the result is that the rates obtained by a considerable section of those engaged, especially in the making-up department of the cutlery manufacture, are very poor, their earnings one week with another amounting probably to no more than 18s. or 20s. I do not know that there is any remedy for this state of things. It is quite conceivable that any organized action on the part of the men for an improvement of their rates of pay would result in the complete destruction of their branch of industry in Sheffield. Union action taken some years ago in the scissor-making trade is said to have produced very injurious effects upon it. In that case the action of the scissor-men's union was not immediately directed to an increase of wages, but to a regulation of the apprenticeship system, in a manner hampering to the trade ; and it is undoubtedly the fact that scissor-making has largely passed into the hands of the Germans. It would be a very grave responsibility to recommend the members of any of the more poorly paid of the staple trades of Sheffield to enter upon experiments which might mean industrial suicide.

There are, however, changes as to which one would be glad to hope that friendly arrangements are possible between employers and employed. In the case of the table-knife and spring-knife grinders, for example, a system prevails which is a not unnatural survival of the old industrial system already described, but which has no present economic justification. It is the almost invariable practice in Sheffield for the grinders of whom I have spoken, if they work in buildings belonging to their employer, to pay a rent to him for their working-places (locally called " troughs ") and the power employed for turning the grindstones. This rent amounts in the case of the table-blade grinders to 7s. a week, and to half that sum from the spring-knife grinders, whose work is of a lighter class ; and the rent is deducted on pay-day from the grinder's earnings. The grindstones and other working equipment are found by the workmen, or, if by the employer, a further substantial deduction is made on account of them from the earnings of the workman. The rates of pay for grinding work, it may be assumed, are in the main fixed so as to bear these deductions ; but I am told that when a grinding station, or, as it is locally called, a trough, has been taken by a workman, he is commonly required to pay the rent whether there has been work for his grindstone or not. An arrangement of this kind must obviously be a frequent cause of hardship. So possessed with a sense of that hardship were the edge-tool grinders thirty or forty years ago that, being well united to the number of about 200, they intimated to their employers that they could not continue to work under such conditions and must insist that they should be provided gratis with the equipment of their craft, while receiving a substantially lower rate of pay than that to

which they had been accustomed. At the same time their union did what it could to facilitate the change of system in the case of masters whose equipment was imperfect. The change was made without any conflict; it has not killed the trade, and the men engaged in it are now making on an average 31s. or 32s. a week. It is a most curious fact that the table-blade and pocket-knife grinders are still working under the unsatisfactory conditions from which their brethren or neighbours, the edge-tool grinders, succeeded in emancipating themselves a whole generation ago. They are, indeed, I understand, seriously considering terms which they might propose to their employers as a reasonable basis for the adoption of a similar change in their own case; but the matter moves slowly and is complicated by the opposition of a small number of persons called "teamsters," who make a fair livelihood by renting several "troughs" and employing from five to 15 grinders in them at day wages.

The most important change which has taken place in the cutlery trade of late years is the introduction of machine forging for certain classes of blades. This began, I believe, about 20 years ago. It has been applied particularly to table blades, in regard to which it is now employed a good deal by first-class makers as well as by those producing knives of inferior quality. The latter, but not the former as yet, use the forging machines to a considerable extent also for the production of the blades of pocket as well as table knives. The result has been that, while the total output of knives from Sheffield has greatly increased, there has been a real and substantial decline in the number of hands employed in blade forging. Under this head I am informed that, while the society of table-blade forgers contained over 600 members in 1869, it now contains only 300, and that to the latter number only about 150 machine hands must be added to make up the total of those now earning a livelihood by table-blade forging. Those who have watched the process of blade forging by hand can hardly fail to regret so considerable a diminution in the number of those engaged in it. Two men are generally employed on opposite sides of a small anvil, with a small fire and bellows close by with which they heat the metal again and again between the different operations. First by alternate and carefully directed blows they mould the flat strip of steel into the shape of a blade, then weld on to it a small piece of iron to form the "bolster" and the "tang" by which it is secured to the handle, and, after the "bolster" has been formed by the aid of a die, they finish the shaping of the blade by another succession of blows. It all requires great care, especially on the part of the smith or superior workman who, while using his hammer with one hand, holds the blade by means of tongs with the other. In the case of spring-knife forging, it should be said, the workman is commonly single-handed. Sentimental interest in work of this kind would, indeed, be idly cherished if the products of blade-forging machines were quite equal to those turned out by the hand-forgers. But the voice of science pronounces otherwise. Professor Arnold, the eminent metallurgical authority at the Sheffield Technical School, has expressed the decided opinion that the heavy blows of the steam hammer used in machine forging fail to bring about that complete interlacing of the crystals of the steel with the carbide of iron lying about them (as shown by the microscope) which is needed to produce a blade of even texture—an effect which is secured by the carefully graduated and distributed blows of the good hand-forger. If so, there seems to be reason to expect that hand-forging will always to some considerable extent hold its own at Sheffield. On the other hand, as the world's demand for cheap knives grows, the machines which turn out five gross a day, compared with the 20 dozen which is the day's production of a very good pair of hand-forgers, cannot fail to come increasingly into vogue.

The wages paid to cutlery artisans, as has been said, vary widely, but to some extent it is possible to classify them. The best paid of the blade forgers, for example, who are called first-hearth men, and to whom is intrusted all specially difficult and important work, probably earn quite £3 a week, and their strikers about 55s. But below these experts come a much larger number of men, making, say, from £2 down to 32s., with correspondingly less for the strikers, and a quite small number drawing as little as 18s.

to 22s. As to the grinders, my informants differed so widely that I have difficulty in arriving at any conclusions. My impression is that, while the edge-tool grinders, as has been said, earn some 31s. or 32s. a week, on the average, the clear earnings of the table blade and pocket knife grinders, after paying their "trough" rents, do not come above an average of 28s.; but that in all cases there is a section of specially skilful men who are able, with diligence, to make quite £2. The best of the cutlers proper, or makers-up, may reach £2, or even more, weekly, but the much more numerous second and third classes probably earn, when slack times are taken into account, no more than 30s. and 20s. respectively, and I have been assured that many cutlers earn still less. There has been very little if any general alteration in rates of wages in the manufacture of cutlery over the last 20 or 30 years. The prices of most necessaries of an artisan's household have doubtless diminished, but house rents have risen considerably. On the whole I am inclined, therefore, to think that, while the majority of artisans engaged in the Sheffield cutlery manufacture earn quite enough to keep them in decent comfort, and some of them a good deal more, there has been little, if any, substantial improvement in the circumstances of an appreciable section, and possibly in some cases a decline. This has been due to the pressure of the competition of cheap foreign goods, and, while it might have been resisted, it is difficult to see how it could have been prevented by trade union action.

At present, happily, the cutlery trade in almost all its branches is more active than it has been for many years. So is the silver and electro-plate trade—the other old staple industry of Sheffield. This industry for a long period held a position of social primacy even in the city of knives. It is little more than a generation since the public-houses of Sheffield commonly reserved a separate room for the silversmiths, into which no members of other trades were permitted to intrude. And it is well remembered by men in middle life that the old-fashioned silversmiths used regularly to go to their work in silk hats and "swallow-tail" coats. These special distinctions have disappeared, but the industry has by no means been receding in importance. Britannia metal spoons and forks of Sheffield manufacture have, indeed, lost the position which they once held in the world's markets. This, I am told, was largely due, in the first instance, to a refusal of the artisans engaged to submit to a reduction in wages that would still have left them with considerably over 30s. a week—a refusal which enabled foreign manufacturers to get hold of the trade. To some extent, however, I should hope that a considerably increased production in Sheffield of spoons and forks of the substance called "German silver" has supplied the place of the dislodged Britannia metal table implements formerly furnished by that city. In North and South America, indeed, English electro-plate has been largely discarded in favour of goods made in the United States, and a like displacement has to some extent occurred in Australia. But the ware which has obtained this success at the expense of our countrymen's products is, though very showy at first, of a very unserviceable character, and so soon becomes discoloured and poor in appearance that there seems to be good reason to expect that many customers who were caught by it to begin with are by this time thoroughly disgusted with it, and will in future fall back upon English goods. Plated ware is made, no doubt, to a considerable extent on the Continent of Europe, but much of it, and notably that produced in Germany and Austria, is, like the American stuff just mentioned, so unsatisfactory in wear as to be dear even at the low prices at which it is offered. On the whole, the superior quality and reasonable, though not absurdly low, prices of British plated goods enable their makers to dominate the bulk of the principal markets of the world. The British production is divided for the most part between Sheffield and Birmingham, and the manufacturers of the former city appear to be by no means discontented with the share of the joint trade which falls to them. They give employment to something like 8,000 persons, of whom probably from a third to a half are women and girls.

The rates of pay vary very considerably, and the actual earnings still more widely in the different departments of the industry. Even in the same branch people are to be found, I am told, working side by side who draw weekly sums varying up to £4 and

even £5 and down to 25s. The number who make anything like the large sums just mentioned is very limited, and is probably confined to the most accomplished craftsmen in several branches, including those who execute and direct the best work in the model and die making, the engraving, and chasing departments in the best silver houses—men whose work will be admired a hundred years hence, as what is left of "old Sheffield" plated goods is justly admired now. For the making of wax or clay models from drawings and the cutting of dies, by means of which designs of infinite variety are reproduced through the action of steam and tilt hammers, "stamping" the flat sheets of metal into the dies, great skill, judgment, and taste are often required. Like qualifications, as need hardly be said, are demanded for the hand-engraving and chasing of elaborate sunk and raised designs respectively. Much of such work is that of men who are true artists in their craft. For the most part the engravers and chasers, who in Sheffield number about 300 each, work in teams of from five up to 15, and in some cases even 20 men, whose work is supervised and directed by a "teamster." He may get his £4 or £5 weekly, and while the best men under him make about £2, the average is probably about 30s. Good men engaged in the important operations of "spinning" and "turning" flat sheets of metal into the shape of vessels of various kinds make up to £2 10s. a week, and their average is about 35s. A similar average is said to prevail among the "buffers" who remove all marks from vessels of the composite metal commonly called "German silver," before the operations of electro-plating and gilding, and the polishers, who give them finishing touches after those operations. In electro-plating and gilding themselves there is a great range of wages, from as high as £3 a week, for the man in charge of a room where the operations are carried on, down to 10s. for some of the boy or girl assistants. On the whole, the larger number of the men engaged in connexion with the production of silver and electro-plate may probably be said to make wages of from 30s. to £2 a week when in work. The women and girls engaged in the trade do not draw by any means as much. Their work requires care and diligence, but not much skill, being principally in such processes as "buffing" and polishing in the case of spoons and forks, and also in the administration of the currents of electricity through baths of cyanide, by which, as is well known, articles of humbler substance mysteriously receive a coating of silver or gold, from sheets of the precious metals suspended in the same acid. It is interesting to note that, contrary to usual experience, the coarser and less agreeable work such as "buffing," in which "German silver" spoons and forks (before being silvered) are scrubbed by a revolving disc of leather and sand, is better paid than the burnishing and polishing, which is very like an ordinary housemaid's duty to her mistress's plate. The buffers may get up to 25s. a week in wages, against 15s. earned by the burnishers and polishers; but the superiority in their income does not prevent the female "buffers" being regarded as social inferiors by their less well-paid neighbours, whose work is cleaner and who, no doubt, are generally of a higher grade. In connexion with the relatively low rates of wages made by many of the women and girls employed in the silver and electro-plate industry of Sheffield it is right to remember that the money so earned is often not the sole source of livelihood of those who obtain it. In connexion alike with the industry just referred to and with those of cutlery and file-making, which are often pursued in Sheffield and the neighbouring villages as an auxiliary "bread-work," a family may be enjoying a substantial total income whose individual earnings seem poor.

The silver and electro-plate trade is subject to variations caused by change in taste and fashion at least to this extent, that manufacturers would feel it unsafe to increase their stock of tea and coffee services largely in the early part of the year in the hope of being able to dispose of it readily in November and December, when, apparently, the great annual demand comes through the retail dealers, from the public. A change in the mode—such, for example, to take a leading case, as the reaction in favour of the simplicity of Georgian designs which has marked the last few years—might set in and make much valuable stock for a time unsaleable. This is the answer given if it is asked why the employers desire, and, as one of the leading firms assured me, their workpeople also, to see a relaxation available in the latter part of the year of the restrictions placed

by the Factory Acts upon overtime and working on Saturdays, and why they should not work steadily in January for the next Christmas instead of going slack as they now do for several weeks over the new year. The general prosperity which the trade now enjoys is doubtless due in no small measure to the greatly improved facilities for the artistic training of workmen which have been diffused of late years both by public action and by enlightened private munificence. More might be done than is done to combine with the excellent training in design now accessible to craftsmen in the precious metals some elements of instruction as to the nature of those metals themselves, and the character of the decorative work to which they lend themselves. The range of subject and treatment where silver is the material is far indeed from being as elastic as in the case of textile materials or even of pottery, and this fact does not seem to be always present to the minds of the art teachers of young silversmiths. Much progress, however, has been made in the æsthetic development of this necessarily small but important section of British workmen, and one cannot see some of them at work without recalling the close connexion which in the best days of Florence subsisted between the art of the craftsman in precious metals and that of the sculptor and the painter.

If space permitted, there are many other departments of the trade of Sheffield and its neighbourhood which would merit detailed treatment, either because of the interesting character of their processes or as illustrating that persistence of old industrial relationships to which reference has already been made, and their modification under new conditions such as the introduction of machinery. Under the former head may be mentioned the manufacture of steel tubing on a large scale, including the attractive operation of tube-welding by means of small portable water-gas furnaces concentrated on the desired spot by a blow-pipe, and the elaborate processes of gold and silver refining, by which the small particles of the precious metals hidden away amidst the refuse of goldsmiths' and silversmiths' shops and dentists' operating rooms are liberated from their base surrounding, brought together, and rolled into bars of pure metal ready for ornamental or useful employment.

The important industry of file-making, again, has been for many years past undergoing great changes owing to the introduction of machinery for cutting the teeth of the files. Three or four years ago the hand cutters of files, supported by many large users of files, sought to promote the adoption by Parliament of a measure requiring that all machine-cut files should be stamped as such. The effort was, however, strongly opposed by the Sheffield Chamber of Commerce and the Cutlers' Company, and after a careful inquiry into the arguments for and against such legislation—which would, no doubt, have been of a quite exceptional character—a Select Committee of the House of Commons decided almost unanimously that it ought not to be proceeded with. It is doubtful whether, if it had passed into law, the measure in question would have checked more than temporarily the substitution of machine-cut for hand-cut files. In any case the substitution has continued steadily, and the trade in machine-cut files from Sheffield, at home and with Continental countries, is very large indeed. That being so, it seems reasonable to assume either that the machine-cut files are as good as those cut by hand and cheaper, or that any defect there may be in durability or other virtues, on account of which it is still claimed that practical men prefer hand-cut files, is more than made up for by the fall in price. In this case the disappearance, if it should come to that, of the handworkers as a class could not excite much regret, as the hand-cutting of files is an arduous and exhausting, even if not definitely unhealthy, occupation.

IX.

THE WEST RIDING CLOTHING DISTRICTS

BESIDES being one of the principal engineering shops, the central part of the West Riding is one of the chief clothing factories for Great Britain and for the world. In the latter capacity, however, as in the former, it is divided into many departments which are largely specialized in different districts. One district makes for one set of markets and another for another set, and so there may be great ups and downs in the prosperity of some towns and manufacturing villages without the occurrence of any corresponding fluctuations in the condition of other towns and villages not many miles away. For they supply different classes of customers, and, while there is very keen competition indeed among the different houses within each department and the district in which it is mainly seated, there is often comparatively little competition between one producing district and another. For example, there is but a limited rivalry, as a general rule, between Huddersfield and Bradford, and practically none between the latter town and the district of which Dewsbury and Batley are twin centres. On the whole, I shoud be inclined to say that the trade of Huddersfield, in its upper grades, is less liable to considerable fluctuation than that of any other place that I know, of which the industry is specially concentrated on certain restricted range of production. The reason of that is that Huddersfield makes a very large proportion of the fine worsted cloth that is worn by well-to-do and well-dressed men. When you see the smart man in his club, in the park, on the racecourse, or dressed for the evening, the chances are two to one—perhaps more—that his well-fitting and spruce garments are entirely the produce of the looms of Huddersfield. An exception must be made, indeed, when he is wearing an overcoat which, if of moderate thickness and smooth surface, will, as a general rule, be made of material produced in the West of England, where the manufacture of " beaver " cloths for greatcoats and also of fine cloths for liveries is still maintained at a high pitch of perfection ; while if he is driving or going by train on a cold winter's day he may very possibly wear an ulster made of frieze produced in the north-eastern province of Ireland. On the other hand, rough cheviots for shooting and generally for country wear in the day time come principally from Scotland, though a good deal of cloth of that description is also made in the West Riding. But for town wear, day and night, and for the evening everywhere, men who dress as distinguished from those who are merely clothed, depend chiefly upon the Huddersfield district. The demand thus created is so large and so constant that, having long established itself as a main source of supply to the merchants who deal with the best London tailors, Huddersfield enjoys a remarkable steadiness in her trade. Nowhere in the world is there so large a class as in London of men who keep from half-a-dozen to a dozen suits going at the same time, and who promptly discard and replace any garment that has lost the appearance of perfect freshness. Their numbers and their effective purchasing power are little, if at all, affected by cycles of bad trade and agricultural depression. Perfectly dressed they must be, and will be, and somehow have no difficulty in finding the means of being ; and the maintenance of their standard of perfection means good business for Huddersfield.

Fashions change, no doubt, in the material as well as the cut of gentlemen's attire. But for many years past these changes have been no more than Huddersfield could easily follow, if not even control. This position has only been attained by Huddersfield, and is only maintained by her through the exercise of great care, energy, and enterprise over a long period of years. Time was when the fashionable tailors of London looked for the novelties in colour and design wherewith they should tempt their critical customers to France. The fact that the looms of Huddersfield have now the precedence in high-class worsted cloths for gentlemen's wear over those of such centres as Roubaix, Reims, and Sedan is largely due to the influence of the excellent weaving and dyeing department

of the Yorkshire College at Leeds and the local technical school in developing a race of foremen and overlookers who understand the true principles of cloth construction—an intricate and difficult, as well as very interesting, art—and of designers possessing the cardinal virtues of originality and correct taste. In one of the great Huddersfield houses alone, under the direction of five or six principal and responsible designers and colourists, you will find forty to fifty men constantly and successfully engaged in devising novelties in the style of "weave" and in combinations of colours. Their labours are to a great extent experimental, and the expert selection from their productions forms the basis of novelty for each succeeding season. At the same time the greatest attention is paid to the maintenance of high quality in the fabric produced. In every part of the processes of production—spinning, weaving, dyeing, and finishing—Huddersfield manufacturers seek to secure the best work possible, and at three distinct stages every piece is carefully gone over with a view to the remedying of any imperfection which may have crept in despite the vigilance previously exercised. This "mending" is all hand-work, and occupies a large number of women, one important firm employing as many as 300 in that department. The net result of it all is that, not only in the United Kingdom, but in France, Germany, and the United States, Huddersfield goods hold a prominent and improving position in the upper ranges of the cloth markets. The well-dressed Englishman sets the fashion to the well-dressed men of other countries, and the styles of cloth which he most affects find increasing favour on the Continent and in America. Thus, even under the M'Kinley tariff, Huddersfield did a good, steady trade with the United States, and both in France and Germany the fine cloths of the same district command a growing sale, despite the energy and resource of the manufacturers and the technical skill of the workpeople in those countries. It should be added that, besides the production by Huddersfield of the special and superior class of goods of which I have spoken, there is also in the district a large output of medium and lower class fabrics, which are sold principally to the merchants in country districts and to the large houses in various places which are engaged in the ready-made clothing trade. These goods, which come under the general designation of tweeds, coatings, and overcoatings, form in bulk an important feature of the trade of the outlying districts of the borough of Huddersfield, and a very large number of people find employment in their production.

In the medium branches of its trade Huddersfield has to encounter the competition of other West Riding towns, notably of Leeds and Bradford, while in cheap woollen goods it works a field largely occupied by Leeds, again, and by the manufacturers of the Dewsbury district. To the latter district and to Leeds some reference will be made in the ensuing article, but it may be mentioned here that, owing to a long dispute between the Huddersfield weavers and their employers in 1883, Bradford succeeded in capturing a considerable slice of the trade in worsted cloth of middle quality for men's wear, and has ever since retained it, besides developing an important manufacture of still cheaper worsted coatings. Generally speaking, however, as is pretty well known, the trade of Bradford, in the past, has been peculiarly liable to severe oscillations between prosperity and depression. These have been due to two main external causes—changes in fashion and changes in tariffs—which still prevail; and to one internal cause, which is much less operative than formerly—a certain disposition of producers to rely upon large orders from a few quarters, together with a corresponding slowness to adapt themselves to changing conditions. The reason why Bradford has suffered so much more than, for example, Huddersfield from changes in fashion is simply that, while the latter town has devoted itself almost entirely to the supply of the material for men's attire, Bradford to a very large extent has laid itself out for the production of dress fabrics for the fair sex. In the spring of last year I described at some length in *The Times* the calamity—for at the time it was no less—which befel the trade of Bradford when about 1875 the lustrous goods, for the production of which the manufacturers and workpeople of that district appear to possess a singular aptitude, went altogether out of use, owing to the onset of a series of fashions in ladies' dress for which they were unsuitable. In the same

article it was also related how the hope of a return of the vogue of " lustres " was deferred over and over again for 20 long years, and how when at last Bradford had to a considerable extent adjusted itself to the altered conditions, and begun partly to provide other materials for the dress of ladies and partly—after the Huddersfield dispute just mentioned—to manufacture coating, not of the first, but still of a good substantial, quality, for masculine attire, down came the American tariff-makers, and did their best to strangle a large part of the new trade. Then it was told how, in 1895, there had been a turn both in tariffs and in fashion favourable to the trade of Bradford, with a result of generally remunerative activity for the manufacturers there, and a few words were said of appeal to the ladies of England to do what in them lay to secure that the efforts which Bradford had made to improve in every way upon the old production of lustrous fabrics should not be neutralized by a further revolution of the wheel of fickle fashion.

The subject was brought by Mr. Wanklyn, one of the members for Bradford, under the notice of the Princess of Wales, and her Royal Highness, with characteristically practical kindness, not only expressed her warm sympathy with the wish that Bradford should be spared the experience of an early reaction of fashion, but herself ordered some beautiful specimens of Bradford bright dress-fabrics for the trousseau of the Princess Maud from a selection which at her request was placed before her, and graciously expressed the opinion that Bradford could have nothing to fear from foreign competition. Her Royal Highness's prompt action and her published words of admiration undoubtedly rendered a valuable service toward checking the already refluent tide of fashion. It was not possible, indeed, to prevent the hidden arbiters of the mode from pronouncing and insisting that, for some inconceivable reason, the choicely coloured mohairs, on the enrichment and diversification of which the designers of Bradford had lavished infinite thought and taste, were to go out, after a brief year of vogue. But the material escaped condemnation and, if mainly in sober black, is still extensively worn, though by no means as extensively as during the glorious days of 1895, when orders came tumbling in much faster then they could be executed. What then, it may be asked, is worn in place of coloured mohair, or of the cheaper bright fabrics made of the long-stapled English wool which people with lighter purses wore when mohair was all the fashion for smart ladies ? Well, partly by the smart ladies, silk and cotton fabrics are worn, and there what is loss to some part of the capital and labour of Bradford is gain to another ; for all the world has heard of the silk mills at Manningham. Lancashire, on the other hand, gains by every increase in the demand for cotton goods, fine or cheap.

But there is another substitution which has been going on in the case of women of almost every degree of wealth, as to which a word must certainly be said. Many of us unthinking men have probably looked upon the immense growth of the use of bicycles by women during the last two or three years as a fact the economic applications of which were confined, for better or worse, to the bicycle makers and the landlords of country inns on the one hand, and doctors and horse dealers on the other. But the truth is far otherwise. The textile industries have been affected in two quite distinct ways by the great spread of bicycle riding among women. In the first place, and quite simply, by way of a very considerable, though temporary, diminution of orders. Those families are probably numbered by thousands, if not tens of thousands, in this and in many other countries wherein the head has been compelled at some moment or other to enforce, directly or indirectly, a choice between a new frock and a bicycle, and there can be no doubt whatever that in multitudes of cases the bicycle has had it. It is not meant that the choice is a constantly recurring one in the same households, for, of course, speaking broadly, a bicycle lasts a good dealer longer than a frock. But in these early years of the great bicycle movement textile manufacturers and dressmakers have undoubtedly felt a distinct resultant contraction of custom. That, however, is by no means its only effect in the same spheres. As there are makes of dress which, while suitable enough for walking, are not convenient for cycling, so it will be readily understood that there are materials which, while excellent for the former purpose, do not lend themselves readily to the

latter. A little further reflection will enable the least instructed of my readers to discern, and if not I trust they will believe that I have it on the best authority, that the light and open texture of the lustre tissues makes them much less fit for the wear and occasional tear of cycling than are the softer, closer-woven fabrics which one associates with women's garments of the tailor-made type. Of course the number of women who can afford to have costumes devoted to bicycling alone is limited, though very considerable. But the number is practically unlimited who, in choosing the material for their ordinary morning costumes, have to consider what will do for bicycling as well as walking, and they no less than their wealthier sisters are drawn irresistibly away from mohairs and other lustre tissues, except as regards gowns to be worn on non-cycling occasions. That being so it may be asked where the dress stuffs suitable for cycling are made, and also the other materials by which, to some extent at any rate, the place of lustres has been taken for other than cycling wear. The answer to this question is not very simple, but my inquiries lead me to think that some fairly trustworthy general indication may be given. Happily, there seems reason to believe that a substantial share of the function of making the non-lustrous tissues now worn by women is discharged by Bradford. The manufacturers of that district have learned the lessons of adversity in no small degree, and whereas ten or 15 years ago a run upon "lustres," followed by a reduction of their popularity, would have meant heavy loss and many a mill running slack, the changes to which attention has just been called have not had by any means so serious an effect. In other words, manufacturers who a year or two ago were running their looms at top speed in the production of mohairs and cognate fabrics have in several cases adapted their machinery so as to turn out either the elegant fancy cycling cloths which are much worn, or serges and other soft and more clinging materials of relatively dull surface and in various colours, which are worn for the promenade or morning call. This fact is not only good in itself, but of most hopeful augury for the future, as to which one may now reasonably believe that Bradford will never be as dependent on the vagaries of fashion and the variations of tariffs as in past days. I hear on very good authority that in respect of elasticity and power of adjustment to varying conditions of trade Bradford has made more progress in the last three years than in the previous thirty. Still without doubt the work of supplying the material for women's dress is more diffused than it was when lustres were so definitely the mode. At Roubaix and elsewhere the French retain a special faculty for the manipulation, particularly at the spinning stage, of the short stapled Australian wools with a view to weaving into cloth of soft smooth texture for feminine attire. This applies both to the smarter fabrics and also to plain serges and twills ; and there can be no doubt that the use of these French fabrics has been considerably more extensive during the last six months than it was 18 months ago. For the rest woollen and worsted cloths for women's wear are made partly in Scotland and partly in other Yorkshire centres such as Halifax, Dewsbury, and, among its singularly diversified industries, Leeds also.

What I have to say as to the latter two important districts, under the head of trades connected with wool, must be reserved for the ensuing article. But Halifax may be briefly dealt with here in connexion with that interesting local specialization of industry to which reference has been made, and to which Leeds is to a large extent an exception. Thus, if I may be excused for mentioning the fact as a very curious example of sub-division of service, while the other places just named provide the cloth used for feminine bicycling costumes, so far as those are the subject of general observation, it is in Halifax and its surrounding villages that there are made the serges extensively used for the knickerbockers which are understood to be worn out of sight. These serges are manufactured with a woollen weft upon a worsted warp, or, in other words, a thread spun from fine, short, dull, curly wool is woven across a foundation of thread spun from long glossy wool. A like blend is to be found in several of the other principal specialties of the Halifax district, though produced for very different markets than the one just indicated. It is so with the very large make of navy serges for which Halifax is noted.

For a considerable number of recent years in succession something like three-fourths of the million yards of serge annually required for our " bluejackets " were supplied from the mills of the Halifax district. This year the West of England manufacturers seem to have secured a larger share of this order than formerly, but, fortunately, the increasing vogue of serge costumes, both for men and women, has, I am told, more than made up for the falling off in custom from the British Admiralty. Army serges are also produced by one or two of the principal firms, and they appear to compete successfully with their West of England rivals. Time was when many important Continental countries looked to Halifax for the clothing of their men-of-war's men, but, one after another, they have developed textile industries of their own, which, naturally enough, their Governments deem it wise to encourage by all the orders they can give them. Halifax, however, still supplies, to some extent, the navies of Turkey and Greece, and in large measure several of the South American Republics, China, and Japan, though in the case of the last-named country it will be matter for surpirse if national industry does not in the course of a few years meet the national demand. Halifax also does a very considerable trade with the East, and particularly with China, in coloured woollen cloths known as " camlets," " lastings," and " long ells " for use in the covering of hassocks for divans and the lining of sedan chairs. But in this there has been a large decline, amounting in all to perhaps half of the ten million yards which Halifax used to send to China, and cheap cotton fabrics, such as " Turkey red," shirting which is made in Lancashire, and which, while presenting a pleasant and cheery appearance, can be sold at 1½d. to 2d. a yard, are preferred by the Chinese purchaser, with the heavy exchange against him, to the more substantial goods at 7d. a yard from Halifax. All these things point to the necessity under which the cloth manufacturers of that district lie of nursing the general home market for their serges and other goods, a necessity which, I believe, is increasingly recognized, and with encouraging results. At Elland, between two and three miles from Halifax, there is an important manufacture of so-called " union " serges woven with a cheap woollen weft on a cotton warp, and used for such varied purposes as " linseys " for the skirts of working women and " art serges " for upholstery.

One other branch of the textile industries is practised in Halifax and its neighbourhood on a considerable scale—that of carpet-making. Worsted yarn is almost exclusively employed, and the whole of the necessary operations are carried on within the same establishments. Weaving is always an interesting if sometimes a rather bewildering operation to the ordinary observer, and there is a special fascination about carpet-weaving, owing to the picturesque manner in which the warp is composed in the case of Brussels and other pile carpets of streams of variously coloured threads, each single yarn running off a small beam, and the several colours being arranged in three, five, or seven frames according to the costliness of the carpet. Such yarns are used solely in the development of the design making the pile, and are regularly stitched to the foundation, or back, of the carpet composed of cheaper and stronger yarns like cotton. There is also something peculiarly attractive about the way in which a minute knife runs to and fro, like a mouse, across the growing fabric, cutting the threads so that they stand erect, when the effect of a velvet pile is to be produced. This is the case with what is called the Wilton or Tournai velvet variety of Brussels carpet. These and what is known in the trade as " Royal Axminster " are the most costly kinds of carpet produced in the Halifax district. This branch of the manufacture would, of course, suffer from any strong set of taste or fashion in favour of carpets of the Oriental type, whether coming from Turkey or Persia, or made in this country, as they are at Glasgow and, to some extent, at Kidderminster. It does not seem probable, however, that any revolutionary change in that direction will occur, though doubtless the tide of taste in carpets will have its ebbs and flows. Considerations of cost render it impossible that there can be any corresponding displacement in the case of the cheap but tasteful " tapestry " types which form the larger part of the carpet production of the Halifax district, and which deservedly command a very extensive sale.

X.

THE WEST RIDING CLOTHING DISTRICTS (*Concluded*)

LEEDS, as has been already remarked, presents a sharp contrast to that tendency towards local specialization which is so marked a characteristic of the West Riding in regard to both the metal and the textile industries. In Leeds and the district of which it is the recognized centre, embracing a large number of manufacturing villages that have grown, or are growing, to considerable towns, almost every form of engineering production is practised. And, similarly, there are very few of those textile products into which wool largely enters which are not in some considerable measure represented in the same district. Leeds is not the principal seat, even in Yorkshire, of the most highly finished and expensive cloth; that distinction belongs to Huddersfield. But Leeds makes a considerable amount annually of high-class cloths, though not the most expensive, for good tailors, and a very large amount of excellent cloth of medium price also for men's dress. These branches of manufacture, which employ probably some 30,000 men and women in the Leeds district, are, like the high-class trade of Huddersfield, very fairly independent of changes of fashion. The manufacturers have, indeed, to study very carefully the production of an adequate show of novelties from season to season, but they are, for the most part, alive to this necessity, and are showing themselves competent to meet it. There is also turned out yearly in Leeds a considerable quantity of highly-finished cloth of the kind which is used for the lining of first-class railway carriages, for military uniforms, and for liveries. The phrase "highly-finished" has a special interest in this connexion, for it serves to call attention to an industrial change which locally has been of no slight importance, and which is distinctly due to a change of fashion in masculine apparel analogous to the disuse of the lustre dress fabrics of Bradford by ladies in the early seventies. I refer to the almost entire disappearance from the habit of men of the fine, smooth-faced woollen material known as broad-cloth. Not only for many years, but for many generations, broad-cloth of different dyes was the regular wear for gentlemen at all times except when they wanted to be very smart indeed. For a still longer period black broad-cloth was the material in which persons of the professional classes were habitually attired, the "cloth" to which old-fashioned bullies always referred when explaining why they could not knock a clergyman down. Within living memory all that has been changed. Roughness has become as imperative as smoothness once was for all persons who do not wish to be considered hopelessly old-fashioned. This roughness varies no doubt greatly in degree from the fine twill of the frock coat in which one appears at weddings to the almost shaggy cheviot in which one tramps over the moors; but real smoothness is not admissible except, curiously enough, for evening wear, and in the hunting-field. This change in fashion has meant the disuse to a very large extent of an elaborate series of processes known as cloth-finishing, for the successful practice of which the West Riding clothing districts in general, and Leeds in particular, long enjoyed a special reputation. Thirty or forty years ago there were probably fifty houses in Leeds district alone who did nothing else but "finish" smooth cloth after it came from the makers, and before it was passed on to the merchants, the three occupations being for the most part at that time carried on by different persons. At the present day there are only some half-dozen establishments in Leeds for the finishing of smooth, or "faced," cloth, and some of those still extant are conducted by persons who are also manufacturers and merchants as well. They are quite enough to deal with the cloth for railway carriage linings, uniforms, hunting costumes, and liveries, which, as was above remarked, is still to a considerable amount produced in the Leeds district. There is an undoubted attraction about the elaboration of the somewhat old-world processes by which the fine even surface of the cloths in question is produced. In the finishing establishment the cloth as it comes from the weavers first has its fibres "raised" by passing through rollers

studded with vegetable teasles. Then those fibres are cropped or cut by a machine, of which, I believe, the familiar lawn-mower was an adaptation. Then the cloth is pressed hydraulically. Then—and this is essential to a face finish—it is boiled. Then, if it has not been dyed in the wool, the piece goes to the dyers. In any case it is subsequently washed with soap and water and stretched in a hot chamber on the " tenter hooks." Then, with a view to getting perfect uniformity in the pile of fibres, the surface is again cropped, this time by a finer set of knives than before ; then pressed again, and then examined for the removal—this is called " burling "—of any burrs which may still adhere to the fabric after all it has gone through. After this, each piece is carefully gone over to discover any defects in the texture, and, so far as may be, they are remedied by the hand-work of women. Once more the hydraulic press is brought to bear, and then the cloth is as good as Leeds can make it. Cumulatively these processes constitute a very notable addition to the price of cloth thus finished, which includes a small proportion of finer worsteds as well as of woollens ; but in most of its branches the work does not require much skill and commands but low wages. Thus the men employed in working the " raising " and cutting machines make no more than 24s. or 25s. a week, and the women who do the " burling " earn only from 9s. to 12s. The women " menders," however, in this as in other departments of the cloth trade do fairly well, their earnings, when fully employed, reaching 16s. a week ; and the men engaged in pressing, which requires the lifting and adjusting of heavy weights, get a weekly wage of 40s. or upwards.

The highly-finished cloths of which I have been speaking sell at from 5s. to 10s. a yard, and the much larger quantity of worsted and woolen cloths of medium quality turned out by Leeds will fetch from 3s. to 6s. a yard. But perhaps the largest trade done by the Leeds district is in cloths ranging from 1s. or less up to 2s. 6d. or 3s. a yard and in ready-made clothes produced from material of that character. Such cloth is also the principal manufacture of what is known in the West Riding as the " heavy woollen district," which comprises the towns of Dewsbury, Batley, Ossett, Morley, and two or three smaller places. As all or most of the world knows, cloth cannot be sold at such low prices without being what is frankly called " low " in its composition. That is to say, it must be woven to a greater or less degree of yarn that is spun partly or altogether from " shoddy " or " mungo." These substances are the products of a machine commonly called a " devil," into which rags of all descriptions—fragments of coats and trousers, women's dresses, stockings, and underclothing of all kinds—are " fed " at one end, and, after passing through a set of sharp knives, are delivered at the other end a soft woolly mass. The " devil " at work is, it must be admitted, a rather grisly spectacle ; nor are the large chambers in which mungoes of various kinds and qualities are blended and stacked scenes lending themselves to very cheerful reflections. Yet it would be very foolish to give way to prejudice in such matters, and I do not think that any one who inquires into the subject with an open mind will be inclined to echo the denunciations of " shoddy " which have been rather common in the mouths of some moral teachers. It is not necessary to associate one's-self with the enthusiastic confidence of a Dewsbury gentleman, who, standing in his warehouse filled with sacks of miscellaneous rags from all quarters, referred to the groundless suspicions cherished by some people as to the sanitary character of these collections, and expressed to me his own cheerful readiness to lie down among them. But it is surprising how free from offensive effluvia rag warehouses can be, and how little olfactory annoyance one may suffer even in presence of the searching operations of the "devil." It is not, however, on any such negative details as these that the case for the shoddy trade rests. It rests on the broad facts that the cheap cloth thus provided, worked up by the ready-made clothier, furnishes cheap, comfortable, and respectable clothing for the million, and that the industries so engaged give employment to many tens of thousands of workpeople. In the era preceding the invention of the " devil " and the development of the ready-made clothing trade, the working classes of this country were, for the most part, clothed either in cotton or in the cast-off garments of the well-to-do. There is much to be said, no doubt, for the smock-frock on the grounds

of its picturesqueness, its lightness, its durability, and its power to turn rain. Corduroys, too, moleskins, and other kindred cotton fabrics possess a power of standing hard wear which can hardly be claimed for woollen tissues of any class and certainly not for those of which shoddy is the base. Clothes of the latter class of material, therefore, will never displace the strong cotton cloths for use by workmen engaged in rough manual work, while they are so engaged. But for wear by men at other times, and by most women of the working-class at most times, the shoddy manufacturer brings within reach clothing of a kind which, alike in its comfort, its suitability to the climate, and its respectable and often even attractive appearance, would otherwise be quite unattainable.

It is in Leeds and the smaller West Riding towns already mentioned that this manufacture is chiefly seated; indeed, the prosperity of Dewsbury and its group of neighbouring towns, which within living memory have developed from insignificant villages into thriving municipalities with populations of from 15,000 to 30,000 apiece, rests very largely upon this branch of industry. Probably more than 150,000 persons in the West Riding draw their main subsistence from shoddy mills, and, speaking broadly, the wages earned there are about the same as in the production of better-class cloth. The number dependent on the ready-made clothing industry, which is concentrated in Leeds, is smaller, but it is very considerable, and it has grown very rapidly. In 1890 one of the best authorities estimated that there were about 10,000 persons engaged in that trade in Leeds. It seems certain that now there are from 18,000 to 20,000 tailoresses alone in the same city, besides some 4,000 or 5,000 men working in various departments of the same industry. An inspection of one or other of the large ready-made clothing establishments has become one of the regular features of a visit paid by any distinguished stranger to the metropolis of the West Riding. And with good reason. Externally some of these great buildings are so impressive in their general design and have so much pleasing ornament as to constitute a real relief amid the gloom and monotony of their surroundings. Internally, also, some of them, though, I fear, not a large proportion of the ready-made clothing houses in the district, are excellently arranged in regard to the provision of light and air to the workers. And there is a lively intellectual satisfaction to be derived from contemplating the completeness and thoroughness of the organization and division of labour throughout the branches of these great establishments on the one hand, and the singular ingenuity of several of the mechanical processes on the other. Notable among these latter are the patent arrangements for marking a pattern, with perfect accuracy, on the top layer of a pile of cloth, and the endless band-knife, driven with great speed by steam, against which the thick piles of cloth are gently guided along the lines of the stamped pattern by a workman, whose steadiness of nerve—for a single slip on his part would mean serious waste of cloth—commands one's admiration. Very striking again is the complicated, delicate mechanism of the button-holer, with its rapidly successive embodiment of a series of nicely-adjusted manual operations. But still more impressive is the manner in which the whole establishment is, so to say, the practical and detailed expression of comprehensive thought applied to the rapid conversion of bales of cloth into articles of clothing ready for immediate wear. No doubt it is true that, as an Eastern potentate acutely observed when being taken round one of the great Leeds clothing factories, one never sees two men made exactly alike, whereas the theory of the clothing factory is that hundreds and even thousands of men and boys are so made. Nevertheless, the great law of averages has its very real applications in regard to combinations of girth of chest and waist with length of arm and leg. The ready-made clothiers recognize a great variety of what may be called normal standards in respect of these combinations, and patience and the adjusting influence of wear do the rest, which, often enough, is no more than is left for them to do with garments made to measure by all but the best artists.

So far as the individual worker is concerned, while there is no doubt a certain social *cachet* attaching to employment at some of the best of the ready-made clothing houses, the work, being specialized within narrow limits, appears distinctly less interesting and

makes less demands on the mind than weaving. Not only is the loom itself always an interesting machine, but at any rate, in a great and steadily increasing proportion of cases, its work is very frequently changing, and there are so many points to be watched that it rarely becomes purely mechanical, and so—although generalizations on such questions, except after very elaborate and extended investigation and cross-examination, must be made with great reserve—it may, I think, be said that weavers' wages are, on the whole, better than those of tailoresses. There is, indeed, I believe, a small section of highly skilled women in the best of the ready-made clothing establishments who, when the earnings of slack times and good times are put against one another, make on the average a net sum of nearly 19s. a week, but the number of these highly paid tailoresses probably does not rise above a very few hundreds in the whole trade, and the wages received by the general body of the female workers in ready-made clothing establishments are something very different. The ordinarily industrious and intelligent machinist, after paying for thread and other materials with which she has to supply herself, does not—bad times with good—secure even in the best houses more than an average of 13s. In many of the houses in the Leeds ready-made clothing trade hundreds of the hands, amounting in the aggregate to several thousands, do not, I believe, make more than 12s. a week even in busy times, and in slack times carry away so little that their average for the year is probably no more than 8s. or 9s., while a substantial section make considerably less than even that low figure.

In weaving as in ready-made clothing there is a small first class of hands who, in good times, make 25s. or more a week, and perhaps 20s. on an average all the year round. But there is, I think, a much larger proportion of weavers than of tailoresses who make when fully employed from 12s. to 16s., a much smaller proportion who make as little as 10s., and very few indeed who in good times make less than 10s. Assuming about the same proportion of slack time for weavers as for tailoresses, the average weekly earnings of the former for the year will probably work out at some 2s. or 3s. more than that of the latter. The rates of spinning wages vary considerably as between workpeople engaged in the production of woollen and of worsted yarns respectively. In the former case that wonderful machine the self-acting mule is generally used. It performs the operations both of "drawing" and of spinning the thread, and it requires a considerable amount of skilled attention. It is, I believe, a common thing for the workman in charge of a mule engaged in the production of woollen yarn, after paying 10s. apiece to two boy assistants, to take home 35s. a week. In the preparation of worsted yarn the operations are more subdivided, the machinery more automatic, and the average earnings of the workers are a good deal lower. Thus the large majority of the spinners in the Bradford district are girls, from 14 to 18 years of age, making from 9s. to 11s. a week; the "drawing" hands, from 16 to 22 years of age, earn about 12s.; "reelers," who are grown-up young women, earn 14s. to 18s. a week, and even the spinning overlookers, who are generally if not almost always, men, make only 30s. or 32s. a week.

In the trades connected with worsted and woollen, as a whole, the number of women employed is very much larger than that of the men, and, whether for that reason or not, the wages earned, speaking broadly, are only on a scale adequate, and, as has been seen, very often barely adequate, for the support of a single individual. It is only by the aggregation of several of these small incomes in a household, together in a great number of cases with the much larger incomes obtained by men engaged in neighbouring metal industries, that the comparatively high level of general well-being which prevails in the clothing districts of the West Riding is made possible. There are great numbers of households in which the combined earnings of the father as a mechanic, an unmarried son learning the same trade, and two or three daughters employed as weavers or tailoresses, amount when times are at all good to between £3 and £4 a week, and even more, and that means very substantial comfort and possibilities, often happily realized, of considerable savings. But, at the same time, girls and women working on their own account, side by side with the members of the cheerful households just referred to, may be finding it all they can do to make ends meet.

Some general remarks on the moral and physical conditions of factory work, especially in their influence on women and children, may properly be reserved for a later article. But there is a department of the textile industry so important in itself, so special to the West Riding, and so unsatisfactory in the conditions under which, to a large extent, it is at present conducted, that, although the number of persons engaged in it is but a very small proportion of the workers in wool, it must receive some brief treatment here. I refer to the operations of and connected with wool-combing, which are carried on for the most part at Bradford, and are, in some form or other, essential to the preparation of the wool for the spinning of worsted yarn. Combing is necessary for the separation of the short, curly fibres of the wool, technically called " noil," from the longer, straighter fibres which in worsted thread must be brought as much as possible into close parallel relationship with one another. Before being combed the wool is washed in what are called backwashing machines, to remove the oil, which was sprinkled on it to prevent the breaking of the fibres in the preliminary process of carding, and other impurities. The backwashing machines contain cylinders charged with steam by passing over and between which the wool is dried. The combing machines also contain cylinders charged with steam for the purpose of heating the wool and the teeth of the combs. It is recognized by experts that the atmosphere in which combing is carried on need not, with a view to the satisfactory conduct of the processes, be kept at a greater heat than 75 deg. to 80 deg. But, owing to the frequent presence in one shed of dozens of combing machines and several back-washing machines and the accumulated radiation of the heat from their steam-charged cylinders, which are often so hot that they cannot be touched without injury to the skin, the temperature, as a matter of practice, is in summer time, in many establishments, usually up to 100 deg., and, I believe, often much higher. I visited one of the principal combing establishments in Bradford on a summer afternoon. The manager, who was most courteous, readily gave me every information. The shade temperature outside was only 66 deg. In the middle of the combing shed a thermometer hanging in a position fixed by the local factory inspector stood at 104 deg., and that was by no means the hottest part of the shed. I am confident that a thermometer in the neighbourhood of the backwashing machines would have registered from 6 deg. to 10 deg. higher. The manager gave me to understand that there was nothing unusual in the heat of the sheds that afternoon, at any rate in warm summer weather. The firm had spent a good deal of money on fans for ventilation and the inspector, I was told, was quite contented. But I felt that I would rather break stones all my life in the open air than work, even for *The Times*, in such a heat as that. I am a strong man, but half an hour of it seemed to me an ordeal. Another large combing establishment was, unfortunately, having a holiday on the evening on which I visited it. There also much had evidently been done in the way of ventilation, and, so far as keeping the air fresh is concerned, I am inclined to believe with success. But not as regards the heat, for I gathered from the manager, who was most obliging, that 100 deg. was a common heat in summer and 90 deg. in winter. Yet I firmly believe that by a sufficiency of fans, combined with favourable structural arrangements, the heat of combing mills can be kept, not indeed at a level altogether favourable to the health of natives of this country, but still at a not uncomfortable or distinctly deleterious height. On the day following that just referred to I visited another large combing establishment and was shown all round it by one of the owners. The weather was, no doubt, breezier than on the day before, but to set against that difference there was also much more sunshine to play on the glass roof of the sheds. Yet the whole experience was different. I did not see a thermometer, but hardly anywhere did I encounter a temperature which, judging by my feelings, came within from 10 deg. to 15 deg. of that which had oppressed me in the first combing mill I visited, and almost everywhere there was a pleasant consciousness that cooler air was coming in from outside. My inquiries lead me to believe that there are a few other combing mills where results as favourable as those just indicated are obtained, but that in the majority of cases it is unfortunately otherwise. In other words, I believe that the larger part, certainly some thousands, of the persons engaged in operations

which are at the foundation of the whole of the worsted industry are ordinarily subjected in summer to exhausting heat which is not essential to the successful conduct of the operations in question, while in winter, equally without industrial necessity, they are daily exposed to alternations between the climate of Bombay and that of England at its chilliest. I say nothing about the wages of these workpeople. They are certainly low, averaging in the case of the men little, if at all, over 20s. a week, and of the women perhaps 12s. to 13s. even when employment is good. The operations on which they are engaged require, it may be, but little skill, though they certainly require continuous vigilance. I say nothing here as to the serious aggravations in the hardships of their lot, due to the extraordinary variations that occur in the amount of employment obtainable in the combing trade, and the uncertainty of forecasting those variations, even from day to day. Economic reasons, more or less sufficient, however unsatisfactory, may doubtless be advanced in explanation of the circumstances just mentioned, and also of the fact, which cannot but exercise an unfavourable effect upon the temperature of the mills, that, when at work, they run continuously through day and night. But the more cogent the considerations are which render difficult and unlikely any material improvement in the rates of remuneration of the wool-combers, or in the regularity of their employment, the more urgent is the need that that employment should be carried on under physical conditions as little injurious as may be. That, notwithstanding the optimistic views taken of this subject by managers, the physical conditions which have been above described as extensively prevailing in this trade are distinctly unfavourable to health, there can, in my opinion, be no doubt whatever. Medical and lay evidence could easily be adduced, if need were, of the remarkable prevalence of anæmia among the workers in wool-combing mills, of rapid loss of weight among them, and so forth. But such evidence can hardly be necessary. Few, if any, impartial persons, lay or medical, can be found ready to maintain that habitual work in tropical temperatures can be anything but injurious to persons not born and brought up in the tropics. That being so, and experience proving that it is possible for combing operations upon all kinds of wool to be carried on without excessive heats, I venture to maintain that the standard of freshness and comfort attained in the best combing mills ought to be enforced wherever combing is carried on. To that end I believe that no fresh legislation is necessary. Factory inspectors are empowered to insist that mills which they inspect shall be kept at a " reasonable " temperature. It may be that in order to undertake the general enforcement of an elevated, or rather reduced, standard of " reasonableness " in temperature inspectors would feel that they needed express injunctions from the Home Office. I should be surprised if the issue of such injunctions were not supported by public opinion in the West Riding, to the conscience of which it cannot but be repellent to realize, what I believe to be the fact, that one of the greatest and most famous of its industries rests upon initial processes carried on largely amid conditions incompatible with lasting good health for the majority of the workers.

XI.

THE LANCASHIRE COTTON TRADE

MANCHESTER occupies the position and fulfils the function of commercial centre for the cotton districts in a degree in which no one town can be said to do the same for the West Riding woollen districts. The amount of cotton actually spun or woven in Manchester at the present day is comparatively small; it probably does not exceed that dealt with by the spindles and looms of one of the second or third grade towns in the great system mainly depending on the industry in question. But there is no firm of any importance, whether in the spinning, weaving, dyeing, or printing departments of that industry in any of those towns—from Preston, Blackburn, and Burnley in the north, to Stockport and Macclesfield in the south, from Rochdale and Stalybridge in the east, to Wigan and Warrington in the west—which is not represented by a warehouse and office, or by an agent, in Manchester. Quite regularly their heads frequent the Manchester Exchange, and they transact their business mainly, if not entirely, through Manchester. This concentration of the function of the distribution of its products makes the Lancashire cotton trade, on its distributive side, as with the exception of that in food, the largest, so perhaps the best organized, trade in the world. Thus the Manchester Chamber of Commerce and those who have spoken on its behalf have always been able to secure from Governments and Parliaments at least respectful, and very often effective, attention to their representations with regard to matters affecting trade with foreign countries and British dependencies.

But even more valuable to the cotton trade of Lancashire than the influence which the Manchester Chamber of Commerce has wielded upon the course of administrative or legislative action has been the manner in which it has served as the intelligence bureau for all connected with the cotton industry. From its earliest days, rather more than a century ago, it has brought together and put in order for the service of its members a vast body of information as to the conditions under which trade in the products of their mills was being, or might be, carried on in all parts of the world. And that information, obtained by the agents of individual firms, has long been singularly early and complete. By every heavy mail the great houses in Manchester receive from their correspondents all over the globe detailed intelligence as to the activity of their neighbours at home and their foreign competitors in distant markets—intelligence which, as a rule, considerably outstrips in the speed of its transmission that furnished, with praiseworthy zeal, by her Majesty's Consuls and the Commercial Attachés to British Embassies and Legations. But, in addition to their mail matter, Manchester merchants are kept in almost constant touch with their branch houses, correspondents, and travellers by means of the telegraph. Indeed, it may be said with some confidence that most of the orders transmitted to them come by telegraph. For this purpose their telegraphic "codes" are specially prepared, extending often to several bulky volumes, which enable their correspondents to express in cipher every point of the complicated details, in respect of style, quality, and dimensions, frequently involved in their orders.

There is, it will be seen, a world wide outlook about the cotton trade of Lancashire, especially in those departments, of "fancy" weaving and calico printing, in which design plays an essential part. The great houses engaged in those branches of the industry are constrained, without intermission, to "survey mankind, from China to Peru," as a race requiring cotton cloth in infinite quantity and almost infinite variety; and their organization, external and internal, is fitted to enable them to study and to meet the changes of taste and the developments of need in that respect on the part of any people at any stage in civilization. At the same time the same firm may be engaged in considering

what novelties in design and colour are most likely to secure a run of fashion in material for coloured shirts and ties for wear by smart people of both sexes in English country houses, and what kinds of figuring have the best chance of winning favour in the muslin-like cloth purchased for their somewhat exiguous apparel by the tribes of the Gold Coast. Fashions change, it is to be understood, in some of the markets of the latter class as definitely, if not as rapidly, as in the former. A few years ago what was called the " rice " pattern was all the rage in West Africa ; but now no manufacturer would think it worth his while to produce anything of the kind for customers in that region, and designs of considerably greater complication are looked for. The question of the source of the influences governing the variations of fashion in the Dark Continent is naturally wrapped in profound obscurity. It may be mentioned, however, as a curious fact that those whose business it is to study the subject have observed, of late years, a distinct convergence of taste among the natives who are reached from North and West African ports respectively, and I am told that the dwellers in the Sudan also show a tendency to adopt similar modes in dress fabrics. In the East, and especially in India, as might naturally be supposed, the desire for novelty which is clearly observable in Africa is much less present. Nor do I gather that in the Chinese markets there is much call for variety of figure-design. There is, however, a cordial welcome for rich colouring in cotton fabrics, both for apparel and for upholstery ; and new combinations of strong oranges, blues, and magentas, which by prejudiced Western minds might be stigmatized as gaudy, command a ready and a steady sale among the natives of the Flowery Land.

Obviously, a trade which permeates all parts of the world, except where arrested by protective barriers, and which not seldom even overflows such barriers at their highest, must be in peculiarly sympathetic touch with all the influences by which the material prosperity of the race is affected. No advance in civilization, no commercial development, no calamity due to human perversity or providential visitation can happen on an extended scale in any part of the British Empire, or in any of the warmer quarters of the world, without being felt in some way or other in the industrial territory of which Manchester is the centre. It may naturally be thought that this great diffusion of the English cotton trade must give it a corresponding stability, the causes affecting it favourably or adversely throughout the world naturally tending, as the saying is, to " average " themselves. And such, in the main, has been the case. There can, however, be no doubt that for a considerable time past the adverse influences affecting the Lancashire cotton trade have very largely outweighed those making for its prosperity. Conspicuous, of course, among those adverse influences have been the calamities of famine and pestilence which have so materially reduced the purchasing power of the natives of India. Taken together the Indian markets, as a rule, account for something like 40 per cent. of the total export of the cotton goods of this country, and of that very large amount it appears that not more than three-fourths has been taken by India from England during the current year. Other very important and, till lately, growing markets are those in South America. These have been so much disorganized and crippled by financial difficulties that the buying power of the inhabitants has been greatly reduced. Further unfavourable influences, particularly in the case of printed calicoes, have been the hostile tariffs in Italy, Spain, and Portugal, under the shelter of which the cotton manufacturers of those countries—often supplied with the best machinery by Lancashire makers—have become increasingly able to meet their requirements. Again, the producers of the more high-class cotton fabrics, both those in which the pattern is woven and those in which it is printed, have suffered considerably from change in fashion and from the bicycling movement among English women. That movement has both exemplified and developed the tendency among the fair sex to subordinate daintiness in appearance to serviceable qualities in materials for out-of-door wear. There are, indeed, some indications in the great vogue of the blouse and shirt in female costume, and the improving style of the very varied cotton materials used for those garments, that there will once more be reasonable rewards for the exercise of the highest taste in the production of printed goods by Lancashire

houses. But for some time past there has been no security, as there used to be in former days, that the most charming designs in such fabrics would obtain a ready sale. Of the two, the manufacturers of fancy woven cotton goods have taken a larger share in recent years than the calico printers of the home custom. But both of them, I believe, have, under the conditions created by feminine fashions and habits of life in this country, been made even more dependent than formerly on external markets. And the demand from those markets, for the reasons already referred to, has for many months fallen far below its normal total.

It is true that there are some favourable features in the situation. Somewhat curiously, considering the climate of Scandinavia, there is, and has been for several years, a steadily improving demand from that quarter for Lancashire goods of the better class, particularly prints. This is all to the good so far as it goes, but of course the custom of the ladies of Norway and Sweden can hardly be expected ever to become a very substantial prop to the prosperity of our cotton manufacturers. A more promising feature in the cotton export trade during the last few years is the steady growth in the amount of Lancashire goods taken by the British colonies. Thus to the British possessions in South Africa the number of yards of cotton piece goods of all kinds exported from the United Kingdom rose from 35,106,000 in 1894 to 50,732,500 in 1896. Similarly the exports of the same goods to Australasia rose from 132,426,600 yards in 1894 to 160,158,000 yards in 1896. No corresponding rise took place in our exports of cotton goods to British North America, but it must be remembered that the Canadian climate is less favourable to the development of such trade than those of the two other principal groups of the British colonies, and that it has been the habit of the protected calico manufacturers of the United States, when their production has gone beyond the demands of their own markets, to "dump" the surplus at ruinously low prices across the Canadian frontier. This process, it may be hoped, will be considerably checked, if not entirely prevented, by the preference to be given to British goods under the new Canadian tariff arrangements. Still, when all is said, any such falling-off as has taken place of late in the Indian demand for cotton goods, accompanied by considerable reductions in custom from another large group of markets, such as the South American, cannot fail to produce for the time very unfavourable effects upon the staple industry of Lancashire.

Naturally those effects are not distributed with any approach to equality over the industrial area concerned. In Lancashire as in Yorkshire there is a considerable amount of local specialization in manufacturing operations. The production of the classes of goods that are sent to India is more concentrated in some places than in others, and they, of course, are feeling the depression most severely. Burnley, for example, where almost everybody is engaged in weaving, not spinning, and where the goods woven are of a very plain type, suitable for printing for the Indian market, is at the present moment, and has for some months, been suffering acutely. The depression has not shown itself there to any considerable extent either in the closing of mills or in their running short time, but in a serious reduction in the number of looms worked at the various mills. The common practice in cotton weaving, in which the looms are much narrower than those in use for the production of woollen and worsted fabrics, is for each weaver to have charge of three or four looms, and in the case of a certain limited proportion of male weavers, the preponderance being largely female, of as many as six looms. Very frequently, however, where more than three looms, and always where more than four, are worked by an individual, he or she is assisted by a boy or girl, as the case may be, called a "tenter," who is paid 5s. or 6s. a week by the weaver. In Burnley at the present time, as for several months past, the six-loom weaver is commonly working only four looms, the four-loom weaver three, and sometimes the three-loom weaver only two. This means that the earnings of the average weaver on plain looms being about 5s. 3d. a week per loom, the Burnley weaver, who in times of good employment has made from 15s. to 25s. a week, is only able to earn from 10s. to 20s. The average at the present time is probably even considerably below the mean of the latter two sums, for the reason that, even of the

looms which are still running, many are often kept waiting after one warp is finished for the next which is to be woven. So general and considerable is this curtailment of production at Burnley that not a few of the older *employes* are found to maintain that employment has not been so bad since the black days of the cotton famine caused by the American War. There is probably hardly any other town in the cotton districts, with the possible exception of Blackburn, in which the mills are so largely concentrated on the production of goods for the Indian and South American markets as they are in Burnley. In Preston, for example, a large amount of employment is given by leading makers of high-class cotton goods for use in the underclothing and in the household equipment of English people at home and throughout the Empire, and that trade appears to be suffering little, if any, depression. In the same town there is also made a large amount of material called "leno," a fabric produced from a warp, in which the threads are crossed over one another, instead of running, as in the weaving of plain cloth, in parallel lines. This material is turned out in many varieties, and is used, among other purposes, for women's dresses, and also largely for children's pinafores. In Rochdale there seems to be much the same depression as in Burnley in the case of weavers employed on plain calicoes for printing, but there, as in Preston, various other fabrics are manufactured, as, for example, twills for women's wear, fancy shirtings, flannelettes, and also carpets. The trade of the great spinning district of South Lancashire, of which Bolton is the centre for fine yarns and Oldham for the medium and coarser ones, is sharing to a very considerable extent in the depression which has fallen on the weaving branch of the cotton industry. It is true that the export demand for cotton yarn has been fairly well sustained during the present year, the shipments from January 1st to August 31st having reached 162,119,200 lb., against 165,642,400 for the corresponding period of 1896. But much the larger proportion of the product of the spindles brought upon the Manchester market is used by English manufacturers, and the consequence of the bad trade in the weaving department has been to lessen the purchases of the latter and drive down the prices of yarn.

This mention of the spinners leads to a brief consideration of the very powerful union existing among operatives of that class. It includes, I am told, all but about 5 per cent. of the adult workpeople engaged in cotton spinning. For many years the relations between this great organization, or the unions which have been gradually federated into it, and the Lancashire employers were of a very amiable character. Strikes and lock-outs were frequent, and immense sums were paid by the unions in support of their members during those conflicts. This unfortunate state of things culminated in a strike in 1892-93 against a 10 per cent. reduction in wages which the masters sought to enforce. It lasted for 21 weeks, costing the unions £150,000, and issued in an acceptance by them of a reduction indeed, but only of 2½ per cent. I have seen no estimate of the loss to the masters through this protracted dispute, but, both directly and indirectly, through the stimulus given by the long intermission of Lancashire supplies to cotton spinning in countries such as Italy and India, it must have been very serious. Both sides recognized that such internecine strife was so disastrous to all concerned that great efforts ought to be made to avoid its recurrence ; and after a good deal of negotiation, understandings were arrived at providing for full and representative deliberation, both local and general, on all wages disputes before any declaration of hostilities. Under that arrangement peace has prevailed for rather more than four years. No local dispute has been allowed to develop into a stoppage of work and no general ground of difference has arisen. Hitherto, however, it has been regarded as something like a fixed point in the policy of the Cotton Spinners' Union that no reduction in the rates of wages would be entertained. They are piece-rates, depending upon the amount of yarn spun ; and the actual earnings vary greatly, both with the character of the machinery and the skill and energy of the workers, ranging from 27s. up to 55s. a week. The average is perhaps about 34s., but the number of spinning operatives making from 40s. to 50s. is very considerable and is probably increasing with the steady production of improved machinery. These earnings are exclusive of

the wages which the adult operative pays to his youthful assistants, of whom, as a rule, each spinner has two. There is no obvious reason why spinning wages should not have some relation to prices for yarn, just as wages in the manufactured iron trade of Cleveland and the adjoining districts are, by agreement, regulated, as explained in a former article, with reference to the declared prices of certain qualities of iron. Such an arrangement appears economically sounder than a rigid rate of wages, bearing no relation to the state of trade. There has, however, been a very strong feeling indeed amongst the cotton operatives against accepting any reduction in the rates of wages, which have now been unchanged for several years, whatever the condition of trade.

This applies to the weavers as well as to the spinners. The weavers are by far the larger class, outnumbering the spinners in the proportion of 3 or 4 to 1. Unionism is not so overwhelmingly prevalent among the former as the latter, but probably something like three-fifths of the adult cotton weavers are in one or other of the federated unions, and their position has been sufficiently strong to enable them without strikes to maintain the piece-rates fixed some 14 years ago, unvaried even in times of depressed trade. The weavers, however, share the burden of bad times with their employers, as already explained, by a reduction in the amount of work given them. It is open to question, in my opinion, whether the falling-off in the employment obtained and in the earnings carried home by weavers adjusts the burden of depression as gently and evenly as would be the case if there were fuller employment at lower rates of wages. For it is reasonable to suppose that there would be fuller employment if the masters, through a diminution in the cost of production, were able to reduce their prices to their distant customers. The operatives, however, are very strongly averse to any reduction in piece-rates, and in preference to this they have seemed ready to face any amount of privation.

It is only in the calico-printing department of the cotton industry that labour organization is not very powerful. In the old days of block printing I believe that the workmen, who were a highly-skilled race, had a strong union. The system of cylinder-machine printing, however, which for many years has been practically universal in the English cotton districts, has greatly reduced the proportion of operatives in the industry from whom much skill is required, though it demands a high level of both manual skill and of intelligence from certain limited sections of those employed. I refer in particular to those engaged in the operations connected with the preparation of the rollers by which the colours are imprinted on the cloth, on the one hand, and in the preparation of those colours on the other. These processes are among the most fascinating in the whole range of manufacturing industry, and no one who has witnessed them will be surprised to learn that the workpeople engaged in them, who are almost entirely men, and also the leading hands at the printing machines, draw wages amounting to from 35s. to 50s., while few, if any of them, fall below 28s. a week. The majority, however, of the men employed in print works—as in the scouring and elaborate bleaching which precede the actual printing and in the dyeing, "clearing," and finishing departments—do only labourers' work at labourers' wages of from 18s. to 24s. About one-fifth of the operatives engaged are women and "young persons." of whom the former earn, perhaps, from 16s. to 20s. a week and the latter from 10s. to 12s. These figures, however, relate to times of good employment, not times like those now passing over the trade of Lancashire.

In conclusion, some observations may be expected with regard to the prospects of an industry which, as I hope it has been made to appear, has a distinctly metropolitan quality. It is metropolitan alike in its scale, in the number of persons—some 700,000 in all—whom it employs, in the range and variety of markets on which it depends, and in the character, at once centralized and comprehensive, of its organizations, both of capital and labour. Is its permanent prosperity assured, notwithstanding severe temporary reverses? I should be misrepresenting the thought of Lancashire if I were to omit to mention that an apparent preponderance of opinion among its capitalists and a very strong body of opinion among its trade unionists is in favour of a participation

by the British Government in some international action for the fixing of a legal ratio between gold and silver, on the ground that the trade of the English cotton districts is so largely with silver-using countries that its prosperity must always be precarious until some effective steps are taken to prevent or restrict fluctuations in the relative values of the precious metals. Apart from bimetallism, on which, however, you will find members of the same great houses divided in opinion, there is the question of foreign competition. As yet, it is not serious in neutral markets. Yet there are symptoms not to be disregarded. It is pleasant to know that in recent years Lancashire printed calicoes have decidedly beaten those of the celebrated printers of Alsace, in the opinion of quite impartial foreign judges. At the same time it is still, I believe, from Paris that the best designs are obtained by our great calico-printers, as they have always been. Further, notwithstanding the steady advance in technical instruction—a subject on which I hope to say something in a later article—German scientific training somehow produces chemists who lead the van of progress in the production of dye-stuffs. Improvements in the British patent laws, which have been urged on the Board of Trade by the Manchester Chamber of Commerce, might tend to rectify the balance in this respect, but could not be expected to do all that is to be desired. Again, the cotton manufacturers of the United States have machinery and work on a system which, in the opinion of some good judges, puts them in a position to become serious rivals of ours in the trade with China. And the quickly-developing cotton industry of North Italy is said to have already provided South America with some cloths, though whether or not on profitable terms I am not able to say. All this may not amount to much as yet, and it is always very easy to overrate the real significance of the occasional underselling of English manufactures by those of highly-protected countries. But such facts as I have referred to need the attention alike of the manufacturers and the operatives of Lancashire. Nothing must be neglected that will bring more science and more art into the daily conduct of our textile manufactures. Nothing must be neglected that will promote the true efficiency of the worker. Nor must demands be maintained that will put the manufacturers, whose profits are far lower than they were 20 years ago, at a disadvantage in the presence of genuine foreign competition. If these principles be acted on, the Lancashire cotton trade, it may reasonably be hoped will remain one of the most impressive and prosperous embodiments of the capital and industrial energy of this country.

XII.

LEATHER, BOOT, AND SHOE MANUFACTURE, AT LEEDS AND ELSEWHERE

THE business of converting hides into leather was, until within the last 60 years, one of the most widely diffused in this and other lands. In the early part of the present century the nostrils of the cross-country traveller were assailed at more or less regular intervals by the pungent odours of the tannery of the market town. There the hides of animals slaughtered for food within a radius of 20 miles or so were treated, mainly by means of the bark of certain trees in England, especially oaks, which are rich in tannin. With us this element in rural life—a little too fragant, perhaps, but still valuable as affording variety of interest and employment—has almost entirely disappeared. The reason is not far to seek. While with a growing population the demand for leather for all purposes was constantly increasing, the local supply of oak bark steadily diminished. Tanning materials had to be obtained in largely-increasing amounts from abroad—oak and hemlock bark from the United States and Canada, mimosa bark from Australia, gambier (an extract from the leaves of climbing shrubs of that name) from the neighbourhood of the Straits of Malacca, myrabalans (the fruit of certain Indian trees) from India, and so forth. Naturally, the trade became gradually concentrated in districts to which these necessary materials could be brought most readily by water or land carriage, and in which there was capital enough to meet the growing charges for them. In the south-east this concentration of the leather industries took place principally in London, especially in Bermondsey, and in the west at Bristol. In the north the same kind of development took place to some extent at Hull and Beverley in the East Riding, at Warrington and elsewhere in Lancashire, on Tyneside, and somewhat later, but on a much larger scale, in the Leeds district.

There for the last 30 or 40 years the conduct of the various processes connected with the manufacture of leather has been the foundation of many considerable fortunes, and the northern production of leather, of which Leeds is now the principal seat, probably amounts to about half or more of the total turn-out of that material in England. Broadly speaking the leather manufacturers of Lancashire are engaged upon the production of the strong, hard material needed for the soles of boots and shoes and for the belting of machinery, and those of the Leeds district and the East Riding on the softer, more flexible, and finer leathers used for boot "uppers." Leather for such purposes as saddlery and portmanteaux is not much made in the North. The chief beginnings of the prosperity of the Leeds leather trade lay in the discovery by a Leeds tanner of a method of dealing with what are technically called "East India kips," which are the hides of the small Indian cattle, not much bigger than those of good-sized English calves. His friends and rivals in the trade scoffed at the idea of spending money and trouble on these little hides, which, indeed, had a sufficiently unhopeful appearance. But he had the inventor's faith and courage, and however many hides he may have spoilt to begin with, as to which I have no information, he soon proved that there was money in the tanning of East India kips. The resulting leather was of good quality and suited the makers of good-class boots; and the supply of kips was generally ample and at reasonable rates. That being so, practical Yorkshiremen were speedily found to follow their successful neighbour's example, and several large establishments were for many years entirely, or very largely occupied in the conversion of these small hides into "upper" leather. The impulse thus given was felt in all branches of the leather trade of Leeds. For a generation all went well with that industry. It had its ups and downs, of course, but, inasmuch as it supplied one of the most constant of human needs and was practically exempt from fluctuations due to vagaries of fashion, it was as good and steady a business in regard to profits as one need wish to be connected with.

For some years past, however, it has not been possible to speak of the northern leather industry in such cheerful terms. Its prosperity, by which is meant mainly its position in the home markets—for exports of British leather have never been very extensive—has been assailed from three widely separated quarters. America and Australia have become very serious competitors in the markets of England with the makers of sole leather in Lancashire. America, India, and, to some extent, Australia are able to supply "upper" leathers of a quality and at rates which make their rivalry more than inconvenient to the tanners and curriers of Leeds. The strength of the Australian competition is mainly attributable to the abounding presence in that part of the world of the various kinds of wattle or mimosa tree, the bark of which, as already mentioned, is imported in large quantities for the use of English tanners. Growing wild, or very easily cultivated at the doors, so to say, of the Australian tanneries, the wattles put those establishments in a position to deal cheaply and effectively with the hides of the rapidly growing number of animals which are slaughtered, not only for consumption by the colonists, but also for the important dead-meat trade with Great Britain. The competition here of Indian with home manufactured leather arises from the extensive development in Bombay and specially in Madras of a tanning industry which is a distinct survival of the French occupation. The methods of tanning pursued in Madras and, as I am informed, in the Bombay Presidency also are almost exactly the same as the old French processes, and as French leather always was and still is perhaps the best in the world, it is not surprising that, with very cheap labour and with abundance of tanning materials within easy reach, the manufacturers of leather in India are showing themselves able to cause some trouble to those in England, even in our own markets. There is, it may be mentioned, a very large importation into this country of East India tanned goatskins and sheepskins, of which as many as from a million to a million and a half are regularly disposed of at sales held in London every six weeks. The bulk of these, it is true, are re-exported to Germany for further treatment there, but many are dressed for various purposes in England.

Without doubt, however, the rivalry which creates the greatest anxiety in those engaged in the leather trade in this country is that of the United States. In 1896 the value of American sole leather imported into the United Kingdom was more than a million sterling, and that of dressed leather for boot "uppers" and other purposes was not far short of a million and a half. The amount of American leather thus imported, which reaches from 28,000 to 30,000 tons per annum, is enough, if it were produced here, to keep 20 or 30 big tanneries going, with the corresponding establishments for the currying or finishing of the tanned hides. That is a serious fact. It may perhaps be said to be partially explicable by the greatly increased demand for cheap leather due to the large development in the manufacture of cheap boots and shoes of late years—a manufacture to which reference will be made further on; and I do not suggest that that demand could have been more than partially met from home sources. One would have thought however, having regard to the prosperity of the northern tanneries a quarter of a century ago, that the home production of leather might have developed to some considerable extent in pursuit of the naturally growing demand for leather of all kinds. Such does not seem to have been the case. There are few, if any, more tanneries in the north now than there were 30 years ago, and, so far as I am aware, there has been no important development of the trade in other parts of the country.

Are we to regard the facts thus briefly sketched as pointing to something like a gradual discomfiture of the British leather industry by external rivals within and without the Empire? Let us briefly consider the general character of the two main branches of the industry concerned. For the most part the function of the tanner, like that of the ironworker, consists in watching and intermittently aiding nature in the performance of a number of interesting (though in the case of tanning eminently unsavoury) operations. Before the process of actual tanning begins the hides are subjected to the influence of extremely foul fermentive mixtures, with a view to the easier removal by blunt knives of the adhering flesh and hair. These operations have to be carefully watched in order to prevent the disintegration, through unduly rapid fermentation, of any of the really

valuable portions of the hides. In this connexion atmospheric influences are naturally of importance, and an unexpected thunderstorm on Sunday has often caused damage to the extent of hundreds of pounds at a tannery where a large number of hides have been left on a cool Saturday in an only moderately putrid bath. The great object of these preliminary processes, besides liberating the true skin from comparatively valueless adhesions, is to reduce it to a gelatinous condition. Only when in that state will it be fit to absorb the requisite amount of tannin from the baths charged with that element in which it is going to be steeped. That is the process by which every putrescible element is purged forth, and from the corruptible covering of a dead beast a substance created which, after due manipulation by the currier, lends itself to all kinds of hard usage, in a degree far surpassing that which can be claimed for any other animal or vegetable product. The process is a long one, divided into many stages. The tan-yard presents a series of pits charged with liquor containing tannin in a regularly ascending scale of strength. The hides have to spend a certain number of days in each liquor, being gradually, so to say, educated up to their full limit of absorbing power, and, while in each pit, they have to be from time to time "handled," that is lifted and turned about, so that every part of them may be submitted to the transforming influences of the infusion wherein they are lying.

In the processes thus sketched there is no very extensive sphere for the introduction of labour-saving appliances. Even so, I fear it is the Americans, and not our tanners, who have made most of the advances which have been made in mechanical arrangements for the charging of the pits with liquors and the moving about of the hides in the pits. But the charges for materials—the hides and the various substances containing tannin—cover a very much larger proportion of the total cost of production in tanning than is debited to wages. This gives the American tanners some considerable starting advantage in the manufacture of cheap sole leather, for which the tanning substances abounding in the States serve very well. In the tanning of superior leather for boot-uppers and other purposes, however, substances exotic to the States as well as to this country are of importance, and as regards these the cheapness of freights to England from the East puts our tanners in a position more than equal at the outset to their trans-Atlantic competitors. The rivalry thus becomes very largely a question of applied science—for tanning is essentially a chemical process—and enterprising and vigilant management. There is a valuable leather industries department at the Yorkshire College, Leeds, where research is carried on and instruction given in the applications of scientific knowledge to leather manufacture, such as the chemical valuation of the materials employed, their selection and use for the production of the various kinds of leather, the most economical working of the various processes, and the best modes of dealing with the by-products. This provision for original investigation and for technical instruction is valuable and creditable to the breadth of view of the local manufacturers, and of the Skinners' Company of London, by whose co-operation the department has been established and maintained, and that its advantages are appreciated is shown by the fact that every place in the somewhat small laboratory is occupied by students from all parts of the country, many of them sons of important tanners, and many investigations have been made in it for the benefit of the trade. Unfortunately its usefulness is limited by the small funds at its disposal, and the consequent want of accommodation for additional students and for many sorts of experimental work.

The future of tanning in the North and in England generally must mainly depend on the extent to which our tanners are ready and able to take advantage of all that can be learned through such scientific agencies as that just mentioned, on the one hand, and from the practice of their American and other rivals abroad on the other. Up to the present, I imagine that conservative habits have prevailed too largely, and that, though there are notable examples of enlightened enterprise and anxiety to bring British tanning altogether up to date in its system and equipment, such cases are distinctly exceptional. Instead of being exceptional, they must become the rule if the leather industry of this country as a whole is to hold its own.

In regard to currying, we have an absolutely fair field. Once tanned, leather can be finished for the various purposes for which it is used quite as readily here as anywhere else. Currying, or finishing, is an industry in which almost the whole of the cost is to be debited either to labour or to machinery, which to a greater or less degree dispenses with labour. Even as it comes from the tanner leather is almost ready to be made into boot soles, but for every other purpose—boot-uppers, saddlery, portmanteaus, chamois leather, book-binding, and what not—it must go through a more or less prolonged series of other operations. Among these are included shaving off of rough surfaces, which are really remnants of quite mummified flesh ; stretching and levelling the hide by means of a " sleeking " iron, which is worked all over it while lying on a table ; brushing ; " stuffing " with oleaginous matter ; further working with the " sleeking " iron, and with a stone, for the removal of whatever oily matter the leather will not absorb, and the production of as even a surface as possible ; and blacking, staining, or dyeing. As will be seen, these operations, which vary a good deal with the purposes to which the product is to be applied, are all directed to the bestowal on the material of the flexibility, elasticity, and strength, and the glossiness of appearance which combine to distinguish the various superior kinds of leather. Almost all these operations can be carried on by machinery, and mechanical appliances for conducting them are in extensive use in America and in several establishments in this country. I believe, however, that, speaking generally, the equipment of the finishing department of the leather producing houses, or of those establishments which are devoted solely to currying, with us is by no means so complete and advanced as that which is quite usual across the Atlantic. I am also told by an eminent authority on the subject that there is a marked inferiority in the British working currier to the artisans engaged in the same occupation in the United States ; so much so that American employers can well afford to pay their curriers nearly double the wages, ranging from 28s. up to 35s., which are commonly paid, the higher figure being, I believe, only reached by the best hands, in our northern currying houses. It is alleged in this connexion that whereas the American working currier is extremely keen over his work and takes a pride in beating his own and everybody else's record in regard to the number of hides on which any particular operation can be performed in a given time, the Yorkshire currier of the present generation is listless and inattentive as compared with his predecessor 30 years ago. This illustrates an aspect of the general industrial situation in England, on which something must be said in a later article. But in the meantime it may be observed with confidence that the state of the leather trade will not allow of any slackness either in enterprise on the part of the masters or in active interest in their work on the part of the men. The race is not lost, or nearly so. The value of finished leather imported into the United Kingdom is not increasing rapidly from year to year, but it increased by nearly a million sterling from 1885 to 1896. I believe that much, if not the whole, of that large sum might have represented the profitable investment of British capital at home, and the employment, at more or less substantial wages, of British labour. The field, as I have said, seems fair enough, and it will be difficult to resist the conclusion that if British capital and labour cannot hold their own in the race, there must be some distinct relative decline in the enterprise of the one and the energy and intelligence of the other. The event, I trust, will prove the contrary.

Leeds is the principal seat of the manufacture of boots and shoes in the North of England as well as of leather, but it is not to be assumed that Leeds boots are made of Leeds leather. That material is, for the most part, of a lighter quality, while the boots made in Leeds have for a long period of years been almost entirely for men and women of the working classes. This has been the speciality of the Leeds district since long before the development of machinery in boot-making. Further back than living memory goes, the village of Bramley, which is within the boundaries of the old borough and present city of Leeds, was noted for the manufacture of a good type of working men's and working women's boots which the makers—" little masters," with from four to a dozen workmen—used to bring down to the Leeds market on Tuesdays and Saturdays, and sell to dealers who came in from various parts of the Riding. Just about half a century ago one or

two firms in Leeds began the production of boots and shoes on a large scale. For 20 years or thereabouts these boots and shoes were still made by hand. Not only so, but each boot, except those with cloth uppers and cotton linings, was the product throughout of the labour of an individual workman, whose apprenticeship had trained him to perform all the various operations involved in boot making. The last was furnished by the employer, but the same workman shaped the different pieces of the uppers and stitched them together, making the holes for the waxed threads with an awl and drawing them through with bristles; cut out the strips of hard leather for the soles and heels, and fastened them and the uppers together either by stitches, or by pegs; polished up and made smooth and even the rough edges; made the eyelet holes for laces; hammered in the hobnails, and, in a word, turned out the complete boot. For doing so, working shoemakers received on the average about half-a-crown a pair, and as they could not as a rule make more than a pair a day, it was a good week when they earned 15s. Women were employed, mainly in their homes, in sewing the cloth outsides and cotton linings to the tops of what were called "Sunday boots" for the women of the working and lower middle classes—work for which they received about six shillings a week.

Within the last 30 years the conditions of this wholesale manufacture have been totally changed. One by one machines have been introduced for performing almost all the operations which formerly were done by hand. But it should be understood that this introduction has taken place not only very gradually, but also in very varying degrees as among the different classes and grades of employers and employed. The sewing machines were the first to be introduced. They were at first a failure because their sewing was not secure, and if one stitch gave way a whole seam was likely to come undone. The discovery of the lockstitch machine, however, soon put this to rights, and for something like a quarter of a century the "machining" together of the different parts of boot "uppers" has been general among these manufacturers. In the first instance, a considerable number of men were displaced by this change, women being always employed in charge of the sewing machines. There was a strike of some duration on the part of the men against the innovation in Northampton and other towns where it was earliest introduced. The resistance failed, of course, everywhere, and did not take a very active form in Leeds; and since then the female machinist has been a regular feature of every boot and shoe factory. Some seven or eight years ago machines were introduced from America into the finishing department, which embraces the processes required for producing a smooth and even edge to the sole and heel, such as grinding them with an emery wheel, polishing them with hot irons, and so forth. In this case no labour dispute occurred—at any rate in Leeds—but a considerable number of the finishers were dispensed with, and some of them, I fear, have not found permanent work to this day. In this case also the use of the machines is now general in the Leeds trade. The same may probably be said with regard to machines for heeling, screwing, and eyeletting. All these are very ingenious devices, of American invention. Thus the heel-making machine holds the strips of leather which go to form the boot heel in a firm clutch, moulds them, and drives nails through them all. It also shapes and nails on an external central piece of leather, round which the iron heel-plate used in some specially strong boots is fastened. The screwing machine, again, is an extremely ingenious piece of mechanism, by which the suitable length of screw is cut off from an endless brass coil of the requisite diameter, and by a very rapidly-revolving motion is driven into its place for holding together the various layers of sole leather. There are other very clever and interesting machines, notably those for "clicking," or cutting out, in large numbers, the sections of leather which go to form the boot upper, and for "lasting," by which the uppers, with the last, a model of the foot, inside them, are with extraordinarily rapidity attached to the inner sole. These machines are to be found in the larger and up-to-date boot factories, but not as yet in the numerous smaller and more old-fashioned establishments. Some of them, indeed, may not be adopted there for a long time, if ever, as their cost is at present so considerable that a large production is needed to make them profitable investments. This fact is not altogether to be regretted, as it secures that there shall not be any very

rapid displacement of hand labour. On the other hand, there are a sufficient number of enterprising capitalists in the boot and shoe trade in Leeds to give it a good prospect of steady development through the introduction of the most improved processes. The large extension of the mechanical element in production, in this as in other trades, may very possibly lead in the end to a greater degree of freedom on the part of the employers generally from trade union interference in regard to wages. At present, however, while trade union activity is strong in the Leeds boot and shoe trade, the operatives' union numbering something like 1,600 members, the relations between employers and employed generally are satisfactory. There is a conciliation board, on which sit an equal number of representatives of masters and men, which, with the very occasional aid of two standing arbitrators and an umpire, has for several years settled all local wages questions, notwithstanding the complexities due to the spread of machinery, in a perfectly amicable manner. Two or three years ago the then standing umpire, Mr. Leuty, M.P., was asked by both sides to fix a *minimum* wage in the leading departments, and did so, assigning 28s. a week to the "lasters," who attach the "upper" to the inner sole, and the finishers; 26s. a week to the "clickers," who cut out the uppers, and 23s. to the pressmen, who cut out the soles. A fair number of the two higher grades are, in fact, rated up to 33s. and even 35s. a week, and I am told that above half the men employed in the trade get 30s. Wisely, the union allows men who are past their prime to work below this *minimum* wage when satisfied of their inability to do a full day's work. But even so the enforcement of a *minimum* wage has led to loss of employment in the case of a good many naturally inferior operatives who have not arrived at middle life.

At present there are, I believe, about 2,000 men and boys engaged in the boot and shoe trade in Leeds, and probably about the same number of females. The latter, who, when adults, are almost entirely engaged in machine sewing, are not members of the operatives' union, and whether from that cause or as a result of the limited economic value of their work, or for both reasons, their wages run low. Some of the smartest and most skilful, no doubt, may draw 15s. or so a week, but the majority, I believe—though opinions on this point are somewhat conflicting—average under 12s. In the cheap slipper making trade the wages of women machinists are, if anything, lower. Many of the women so employed, I think, rarely make more than 10s. a week, though probably the piece-work rates allowed by some employers enable a fair number of those machinists who work at home, without any legal limitation of hours, to secure substantially higher earnings. This branch of the industry has for several years been almost entirely in the hands of Jewish immigrants from Eastern Europe, who have settled in Leeds in very large numbers. There, as elsewhere, their influence has largely tended to a cutting down both of prices and wages, and the result has been, I fear, the ruin of several small houses formerly engaged in the slipper trade, and a considerable amount of hardship among operatives of both sexes who had long been employed in that manufacture. That is the sad side of the picture. Looking forward, however, there seems much ground for encouragement. Facts to which reference has already been made seem to point to a steady increase in the introduction of machinery in the Leeds boot and shoe trade, with, perhaps, as little of friction between employers and employed and of distressing dislodgment of labour as can ever be connected with that process. As their mechanical resources develop, the more enterprising of the Leeds boot and shoe manufacturers, we may hope, will be enabled to increase their output, not only in quantity but in variety—to engage, for example, much more extensively in the production of goods of a lighter and finer class than those for which they have hitherto been principally noted. If this happens, the local industry will both employ larger numbers of men and women, and will become much less liable than it still is to fluctuations in activity due to the variation of seasonal demand.

XIII.

COAL MINING

COAL mining is in many respects an industry by itself. It is absolutely essential to the prosperity and even to the existence of all the manufactures, and to the comfort of all the dwellings, of this country. It is thus constantly assured of a vast and varied demand, which must tend, on the whole, towards steady increase. The total output of collieries in the United Kingdom was greater in 1896 by 5½ million tons than it had ever been before, reaching the enormous figure of 195 million tons, and it seems by no means impossible that, notwithstanding the stoppage for many months of a large part of the engineering trade, the returns for 1897 may show an equal or even greater result. Here, as usual, I speak with special reference to the northern counties. Northumberland, Cumberland, Durham, Yorkshire, and Lancashire furnished rather more than their proportion of the increased output noted in 1896 over 1895. Their total production in 1896 was about 90 million tons; and if we add, as, geologically and economically, we ought to add, the 18 million odd tons raised in Derbyshire and Nottinghamshire, we get to a figure exceeding by 13 million tons a moiety of the entire coal output of the United Kingdom.

As there is no reason to believe that the production, great as it was, more than met the demand here and abroad for British coal—the amount of coal exported to foreign countries in 1896 being close upon 33 million tons as compared with rather under 31¾ millions in 1895—it would be natural *prima facie* to suppose that the coal trade of this country in general, and of the North of England in particular, is in a prosperous condition, and yielding on the whole handsome profits to those whose capital is engaged in it. If any British manufacture were in a like position—able both to meet the whole of a great and growing home demand and to sell an increasing surplus abroad—everybody with money in it would be in buoyant spirits. If British agriculture had a like tale to tell, there would be no need for Royal Commissions to inquire into its depression. Nevertheless the coal trade is not now, and has not for several years past been, at all generally in a prosperous condition. The profits, that is to say, which have been realized upon much the larger part of the capital invested in it within the last half decade are not such as to tempt any man who had not already placed his money in coal mining to embark in that kind of investment. Indeed, over a very considerable portion of the northern mining districts it is doubtful whether any commercial profits are being realized at all.

At the first blush this state of things may seem somewhat surprising. But the explanation is not far to seek. It lies in the great differences that exist between the costs of producing and getting coal to the market from differently situated pits, in the variety of the quality of the seams worked, and in the fact that the prices under a system of open competition are inevitably driven down by the action of the pits which are most advantageously placed. In much the larger number of the northern coal mines the cost of producing coal has for many years been steadily increasing. Their best seams have in many cases been worked to such a distance from the bottom of the shaft as to raise very greatly the expense of bringing the coal from where it is won to the surface. Often their owners have had to keep the pits going by working seams which are either of poorer quality, or, being thinner, are more costly to work than those from which for a long period coal had been hewn. This is the case in regard to Lancashire, notwithstanding very much the greater part of the coal of all kinds produced in that county finds a market for industrial or domestic purposes within some 30 miles or less of the pits where it is won. It is also largely true of the West Riding, of Durham, and of parts of Northumberland.

But there are pits in several parts of the northern coalfield where the seams of coal are so exceptionally good and easily worked that their returns are very considerable. That is so with the best of the steam-coal collieries in South Yorkshire. The seam they work is the well-known Barnsley Bed, which has a great reputation for steam coal. Being thus in great demand at home for locomotive purposes, and being also exported, nothwithstanding high railway rates to the shipping ports, in increasing quantities, it commands fair prices, and, being won with comparative ease, the profits to the owners give a reasonable return on the capital invested. The same may be said of several of the Northumberland pits. The coal produced there, indeed, may not have the great prestige of the Barnsley Bed for steam coal or of the Silkstone or old Wallsend for house coal. (The latter celebrated colliery, by the way, is being opened out again by pumping operations, which are clearing it of the water by which it was swamped and enabling new workings to be opened up.) The Northumberland pits, however, to which I have referred produce excellent coal, and the seams worked are reached at depths of from 80 to 160 yards, or from under a half down to a fifth of that to which shafts to the South Yorkshire seams have recently had to be sunk. This, of course, is a great difference in favour of the Northumberland pits in respect of the cost of production. They, and also several of the great collieries in the eastern part of the county of Durham, are specially well placed in respect of access to seaports or navigable rivers, and they accordingly do a very large trade with the South of England and the Continent. In 1896 the coal shipped from the Tyne alone almost reached 12 million tons. These fortunate collieries in Northumberland, Yorkshire, and elsewhere are but a small minority of the total number of pits working in the North, but the less well-placed have to adjust their prices to the standard set by their lucky rivals.

And new rivals are ever springing up. Within the last half-dozen years half-a-dozen important collieries could be mentioned which have been opened to work one part or another of the great Barnsley Bed, which not only lies under a large part of South Yorkshire, but has also been ascertained to extend widely under Nottinghamshire and Derbyshire. Large amounts of capital are needed to work this seam—called the " Top Hard " in the two last-named counties—as the depths to which the new pits have had to be sunk to reach it range from 400 to 800 yards. But that capital has been obtained without difficulty, and the new collieries are being laid out with every possible improvement in regard to surface arrangements for the mechanical sorting of the different qualities of coal produced by the same seam, and with preparation for the introduction of the best modern means of haulage of the coal underground after being hewn. For the present, however, and for some time to come, the haulage costs in these pits are very small compared with those in pits where, as in many of the large collieries of older date, every ton of coal has to travel from one to two miles before it can see the light. These half-dozen new collieries are—or soon, I am told, will be—in a position to raise on the average 3,000 tons a day each, which, allowing for 250 full working days in the year, means an annual output of 4½ million tons. It is needless to point out how a competition of this character, growing so rapidly, affects the position of the older collieries, many of whose plant is of a much less modern description.

No doubt it is true that most of the latter have had their good times—not a few of them times of almost royal prosperity—while they were working out their best and easily accessible seams and when coal commanded far higher prices than it now does (it has fallen more than 25 per cent. since 1890). But that fact, human nature being what it is, cannot be regarded as affording a constraining inducement to them to continue coal-mining, with all its anxieties and responsibilities, for an indefinite period at their present extremely low rates of profit, or even at an actual loss. As it is, they hold on in many cases partly for the sake of the multitudes of families which are dependent on colliery work for their daily bread, partly because of their aversion to writing off as loss great amounts of practically irrecoverable capital, and partly because they cling to the hope that good times will come round again. So they may, and here it may be well to

interpolate a remark in qualification of the general economic position taken above. The coal trade, it is true, is much less liable than many other trades to material fluctuations in demand from year to year. But, to judge from the past, it is liable to experience, at irregular intervals of years, sharp accesses of demand which produce rises in price so considerable as to give good profits to all then existing collieries, until the necessary time—some three or four years, it may be—has elapsed for the sinking of new pits, by which the demand is again fully overtaken and the price brought down. No one can tell when an experience of this kind may recur. In the meantime, however, it is a question of immense interest to the lessees of the older collieries whether, under existing commercial conditions, their profits might be improved. That apparently could only be done in one or both of two ways—on the one hand, a diminution in the cost of production of coal and, on the other hand, an enhancement of its price.

Is it possible that the cost of producing coal at the older collieries could be so much reduced as to make even present prices fairly remunerative to the coal-owners? By far the largest item in the cost of production of coal is the charge for labour, which amounts to something like 70 per cent. of the whole. There are, of course, two main ways by which labour cost can be reduced—reduction of wages and the substitution of machinery for hand labour. The average daily earnings in money of a collier or hewer—that is, of the man actually engaged in "getting" the coal out of the seam—appear, so far as the North of England is concerned, to be highest in South Yorkshire, where for the three months ending with the 30th of June last the figure returned by the federated coalowners was 6s. 7½d. In West Yorkshire and in Lancashire it was almost exactly 6s. In Durham and Northumberland, where there is a much more complete system of representative negotiation by coalowners and miners than is to be found in other mining districts, 5s. and 5s. 6d., respectively, is the "county average," which is fixed by mutual arrangement. It is usual, however, in the two most northern counties, and not elsewhere, for miners to hold houses rent free from the coalowners for whom they work. This privilege may be considered equal to 3s. or 4s. a week all the year round, for the arrangement subsists without variation through any times when the miner is unable to work by reason of accident or illness. In Northumberland and Durham, again, it is usual for the miners to obtain coal for their households from the collieries at which they work either gratuitously or for an almost nominal charge. No such practice as that is general in the other northern mining districts, but in Yorkshire it is common, especially at the older collieries, for house coal to be supplied at the pit, either free, or for some such low rate as from 2s. to 3s. a ton, to the miners, who either pay for getting it to their cottages or fetch it themselves. The variation in respect of perquisites makes it difficult to compare very closely the remuneration received by the miners in different districts. The actual money earnings are also, of course, affected materially by the number of days worked. Thus I am told that the Lancashire miner, having longer hours, frequently only works, of his own choice, four days a week, while the Northumberland and Durham miner, having shorter hours, works, oftener than not, 11 days a fortnight. Again, the average number of days per week worked at some house-coal pits in West Yorkshire, where they run very slack in summer, may be but little over four, while at steam-coal pits it may be nearly five and a half. Having regard to all these circumstances, I should judge that many thousands of colliers in Lancashire and several thousands in Yorkshire do not average more than 24s. or 25s. a week all told, but that many other thousands in Yorkshire earn up to 33s. a week, that the majority of Durham miners make nearly the latter amount, including house and coals, and that the Northumberland miner's total weekly earnings frequently rise to 35s.

I am far from saying that this scale of remuneration is economically inadequate in existing circumstances. The hours spent in actual labour by the coal-hewer are, indeed, shorter than those worked in any manual calling that I know of. In Lancashire and Yorkshire I believe that the time spent in active exertion at the "working-face" by the hewer is seldom much more than seven hours, and in Durham and Northumberland it is seldom more than 6¼, the coal getting there being done in two short shifts of that

length. (The long shift of about ten hours is worked in the two northernmost counties by the boys and young men who drive the ponies drawing the tubs along the main pit roads, and " put " the same tubs by hand from the " working face " to the main roads.) The working hours of the largest and most characteristic class of persons employed underground are undoubtedly short. The conditions of work in mines have been improved immensely during the last 30 years, both through the enforcement of legislative requirements, in regard to ventilation and other matters vitally connected with the safety of underground working, and by the development of a sense of responsibility on the part of coalowners. Thus it is that the air of a coal mine is, as a rule, distinctly fresher and pleasanter than is to be met with in all but the best-ventilated factories. It must be so, for unless a free circulation of air is maintained throughout the workings there would be, in all " fiery " mines, imminent danger of disastrous explosion. But if, in regard to that very important matter, safety and comfort go together, it is not so in all respects. Where, as in most Northumberland pits, supposed to be happily exempt from dangerous gases, naked lights can be used, the gloom of the dim galleries in which the coal is being " won " for the service of man is far less profound and depressing than in the fiery pits, where the use of anything but a safety-lamp is criminal madness. And even at the best, the murk, the grime, and the constant, if latent, sense of the lurking neighbourhood of death, in falling roof or side, as well as, in so many mines, from the ignition, despite all precautions, of gas or dust—these things make the life of the miner such as his fellow-countrymen would not care to think of as ill-rewarded. The colliers constitute a valuable element in the Industrial North. Especially in the numerous small towns where they are the preponderating element in the population, and in the pit villages of the northern counties, where the surroundings of their homes, but for the chimney and engine-houses at the head of the shaft, are pleasant and rural, the miners form a class the majority of whom are not less respectable and orderly in their daily lives than they are full of readiness to face mortal risk for the aid of comrades imperilled in the bowels of the earth. Nor do I think that coalowners as a class, hard as many of them may feel their commercial position to be, are disposed to seek relief from it by reduction of wages.

What then remains ? Is it possible to any large extent to lessen the cost of production of coal by the introduction of machinery in place of some of the necessarily costly labour now employed ? Here a word must be said on methods of getting coal. Some is simply quarried out of the seam by the miner, who stands or kneels or crouches in front of it, according to its thickness and the corresponding height of his " working place." But very much the larger part is obtained by what is called " holing," or in Durham " kirving," at the bottom of the seam. This means that the miner hews out a recess from 3 ft. to 6 ft. in width by, say, 10 ft., or more, in length, under the seam. This is done either in the coal itself or in the earth, invariably called the " dirt," below the coal, according as the one or the other is easier to deal with by means of the pick. The result of this operation obviously is that the untouched part of the coal seam is left with no support below it and all the weight of the super-incumbent strata above it. What more is necessary to bring down the undercut mass in pieces suitable for loading into the tubs is effected by wedging and, where the adhesion to the upper stratum is very strong and the mine is not too liable to eruptions of gas, by shot firing. The most arduous and, on the whole, the most skilful, and therefore the most costly part of the labour involved in the processes just described is the " holing " under the coal. In a large proportion, as I believe, of the coalfields of the North of England the usual practice is for the recess made by the hewer to be carried about 5 ft. under the coal, and to do that it is necessary for him to use his pick, lying underneath the mass of coal which he is preparing to dislodge. As he proceeds it is necessary for him to introduce short props of wood to prevent the coal from descending prematurely. It is this work of undercutting, obviously fraught with liability to accident, which can be done, and is now being done in several north of England collieries, by mechanical means. The coal-cutting machines which I have seen in operation are worked by compressed air supplied by indiarubber piping from an air-compressing engine on

the surface. Through a series of toothed wheels the engine of the "iron man," as in some places it is called, is connected with the circumference of and drives round with great force a horizontal steel wheel some 4 ft. to 5½ ft. in diameter, furnished at intervals with very strong and sharp teeth or cutters. Moving forward on tram rails laid for the purpose, this machine cuts its way cleanly and with astonishing rapidity under the coal seam to the depth of the diameter of the cutting wheel, leaving a gap about 6 in. high at the bottom of the seam. All that is left to be done by the collier's hand in the actual "getting" of the coal in these cases is the bringing down of the unsupported mass of coal in lumps of convenient size for piling into the tubs. The great leverage which is given by the very deep cut made by the most improved machine dispenses to a large extent with the need of explosives, as is shown by the fact that the number of shots required at one West Riding colliery which I visited has been reduced from 40 to five per day. This obviously means a material increase in safety, as well as in economy of working.

Considerations of space forbid my going into detail with regard to the economic results of these machines. There is, however, no doubt that where I have seen them at work—and a most interesting and impressive spectacle it is—in the West Riding and in Northumberland, the result of employing coal-cutters has been very nearly to double the amount of coal produced per man employed in the work of coal-getting in the pit areas to which it is applied. The earnings of the men employed in following the machine and bringing down and piling or "filling" into tubs the coal which it has undercut probably exceed by 9d. to 1s. the average daily earnings of the district. It is impossible to say, however, whether that fact is an indication of the rates of wages which would prevail if mechanical coal-cutting became general, instead of being as at present altogether exceptional. The whole question is in an experimental stage, and it is probably a sense of the magnitude of the issues that may be involved in it which has prompted the miners at an important West Riding colliery to the indefensible course of carrying on a strike against a very substantial wage-rate fixed by an arbitrator for the work of following a coal-cutting machine. Other essential elements in the calculation are the durability of the coal-cutting machines, the strain on all the parts of which is tremendous, and the cost of providing and transmitting the power for working them. This, of course, is comparatively small where, for example, plant for compressing air is already in operation for purposes of pumping and haulage. Where special plant would have to be laid down its cost is serious. The question of safety also may come in. For it is conceivable that electricity might be the most economical motive power for working the coal-cutting machines, and yet that the electric motors required for the purpose underground might, through "sparking," be a source of danger in fiery mines, which could not be effectually obviated. It is hoped, however, that what is called the "multiphase" system, now being introduced, will to a great extent reduce this objection. All that can be said at present is that in several pits mechanical coal-cutting is in use to the satisfaction of the coalowners (and workmen too), especially in the working of thin seams, where the cost of manual labour in proportion to the quantity of coal produced is highest. Having regard to that fact I should be disposed to think that among those of the less well situated coalowners who have the most enterprise and capital it is probable that there will be a considerable increase in the use of coal-cutting machines during the next ten years. The same class of coalowners are likely also to diminish their costs of production and enhance the selling value of their output by the more extended employment of coal-washing machines, for dealing with coal from seams in which earth is mixed up. Plant for this purpose is already in use at some collieries with very good financial results. By such mechanical developments as these and careful economy of general administration—though it is especially important that economy in mine management should never degenerate into stinginess—we may hope that a fair proportion of the older pits, which have prudently reduced their capital account, will be able to hold on even without a rise in prices. But where the requisite conditions for improvement in methods of working—that is, abundant energy and capital—are not

present, it is difficult to see how, without a sensible rise in prices, a large number of the older collieries—of which there are probably several hundreds in the Northern counties alone—can fail to be shut down before the next century has reached its teens.

Into the complicated question whether the prices of fuel, which have been run down by the kind of unequal competition which has been described, can be raised by any kind of common arrangement to a level which would enable the worst-placed pits to live I have no space to enter. More than one ingenious scheme has been put forward with that view. One in particular, suggested by Mr. Ratcliffe Ellis, of Wigan, secretary of the Federated Coalowners of Yorkshire, Lancashire, and the Midlands, avoids the creation of any commercial organization so vast and formidable as a Coal Trust possessing the sources of the fuel supply of the United Kingdom ; but it proposes that existing coalowners should form themselves into a limited company for the purchase and resale, at prices to be arranged, partly by district boards and partly by a central board of the company, of all the coal produced by its members. It is very easy to point out difficulties in the way of any such project, and there can be no disguising the fact that the public would regard with very hesitating sympathy any scheme which was intended to keep fuel above its competition price. At the same time it seems worthy of remark that if the owners of a considerable proportion of the total present coal supply of the country are starved out, and their pits are withdrawn from competition, prices must rise, at any rate until new pits have been opened or developed to overtake the demand. Such a change would also be necessarily accompanied by a painful development of poverty among, and a practical dislodgment of, a numerous section of the mining population, who would have to find work away from their present homes. The onset of these evils would probably be a good deal hastened by any such measure as an Eight Hours Act for all underground hands. It would operate with special hardship at the older and smaller pits, where a certain amount of elasticity in working arrangements is necessary for the maintenance of any kind of profitable competition with the large and highly-equipped newer collieries. The passage of a Miners' Eight Hours Bill would be likely to cause the rapid closing of an appreciable number of the less fortunate class of pits, with the result, not only of much local loss and distress, but of a sharp rise in coal-prices, producing widespread industrial and general inconvenience.

XIV.

THE CHEMICAL INDUSTRY

THE scale of the world's chemical, and very specially of its alkali, manufacture affords, and that not only on the material side, a fair measure of the diffusion of the elements of civilization. If that trade had not attained its present development we should still as a nation be unlettered and unwashed—paper, soap, and (a substance in many ways hardly less important) glass would have been commodities the use of which in any but very limited quantities was quite out of the reach of the mass of our population. The alkali soda is the chief magic agent by the operation of which things common and even despised in themselves—rags, wood pulp, animal fats, and sand—have been converted in vast quantities into substances affording the vehicles for mental instruction and information, the means of bodily cleanliness, and perhaps the most essential physical requisite of domestic comfort. The same kind of function is, indeed, performed by another alkali, potash, and, down to the end of the last century, that substance, obtained by the evaporation of water in which wood ashes had been boiled, was almost exclusively employed as the alkaline agent in the manufacture of the articles to which we have referred. But, owing to the destruction of forests, potash, long before the discovery of the great Stassfurt deposits, began to be inconveniently scarce, just when, owing to the growth of population coupled with a somewhat more than proportional development of the desire for reading, washing, and windows, the demand for its compounds was making large advances. It was the Government of Louis XVI. that offered a prize for the invention of a method for manufacturing soda from common salt, which prize was won by the great chemist Leblanc. Soda, though known to possess properties similar to those of potash, had been obtainable only from the ashes of sea-plants, a source of supply which in practice was capable of very limited expansion. Leblanc's discovery at once made available a source of supply practically limitless. The circumstances of political and social catastrophe amid which his brilliant researches were brought to completion were fatal to the realization of any commercial reward by the discoverer. But his method was the foundation of the chemical industry of this and other countries. Not only so, but it was the only method in use for the production of soda on a commercial scale till about a generation ago. Since then it has been subjected to a severe and, as years have gone by, increasingly dangerous rivalry.

The development of that rivalry, together with its modifying influence upon the Leblanc soda industry, in the struggle of the latter to maintain its position, constitutes a feature of singular interest in the alkali manufacture, to which, as the root, or at least the stem, of the now highly diversified " chemical " trade, I propose to limit my remarks in this article. To follow to any good purpose the ramifications of that trade generally would consume much more space than I have at command.

What the Leblanc process set out to do was to make soda in its various forms—such as carbonate of soda, bicarbonate of soda, caustic soda, &c.—from common salt. Now common salt, of which the chemical name is " sodium chloride," is composed of two substances, sodium and chlorine, which are chemically combined together and cannot be separated from one another by any other than a chemical operation. The Leblanc process is divided into two main stages. First it decomposes the common salt by the agency of sulphuric acid. A preliminary process therefore is the manufacture of sulphuric acid. For that purpose, pyrites (a substance containing much sulphur) is burnt in specially contructed kilns. The gaseous products of the combustion, chiefly sulphurous acid, are conducted, in company with nitric acid gas, steam, and air, into and through a series of large chambers lined with lead, where, through a subtle intermediary action of the nitric acid gas, nearly all the sulphurous acid is converted into sulphuric acid, which is deposited in a liquid condition on the floor of the chambers.

From tanks in which it is stored the sulphuric acid is delivered by a pipe, the amount being regulated by the workman engaged, into a covered cast-iron " pot," which is heated by the waste gases from an adjoining furnace with which it communicates. Into the same pot there has previously been charged by the same workman a given weight of salt. At the proper time he pushes the " charge " with a long-handled shovel into the furnace, when it is raked and turned over by another workman, who in the end draws it out. (Disagreeable and fatiguing work, as may be imagined, these men have, but I believe, if proper precautions are taken and the plant is kept in good condition, not necessarily unhealthy.) What went in as common salt does not come out as such. There has been an exchange of partners. Not chloride, but sulphate, of sodium is " drawn " at the back door of the furnaces, while hydrochloric acid, which is chlorine combined with hydrogen (obtained from the liquid sulphuric acid), escapes as a gas, to be dealt with, and considered by us, later.

In the second main stage of the Leblanc process, the solid sulphate of soda (or, in the language of the trade, " salt cake ") is mixed, in certain proportions, with coal and limestone and heated to a high temperature in another furnace. The chemical operations ensuing are complicated, but in the result there is another exchange of partners. The carbonic acid of the limestone (aided by that of the burning fuel) lays hold of the sodium and forms soda, or " sodium carbonate," which is the compound sought, and the sulphur discarded by the sodium unites with the calcium of the limestone to form " sulphide of calcium," the principal ingredient in what is commonly known as " alkali waste," The complicated chemical operations thus indicated appear to be assisted by the fact that the furnace in which they occur moves slowly round, whence it is called a " revolver." When its work is understood to be complete, the whole charge is withdrawn in a molten form, bearing on the face of it no indication of the two entirely distinct compounds of which it consists. To separate them it is further necessary, after the molten flux from the furnace has been allowed to cool, to break it up and subject it in vats to the action of hot water. The result is that the soda, or carbonate of sodium, goes into solution, while the sulphide of calcium remains insoluble. The solution in which the former is dissolved is either converted into caustic soda or is evaporated, and the soda lies revealed in a crystalline form, ready to be converted by further treatment into " soda ash," the familiar " soda crystals," and other soda products.

Such in its broad outlines was the Leblanc soda, or, as it was commonly called, the alkali industry, as it flourished for something like two generations in this country and elsewhere. It was in the main very prosperous. It greatly facilitated the general advance of civilization, no doubt. But it made desolate and nauseous the neighbourhoods in which it was seated. It had no need to utilize the substances, which, as readers of the brief sketch just given will have observed, are left aside at every stage in the series of processes leading up to the production of soda. And accordingly it let them escape up chimneys, if gases, and threw them outside the works, if solid. The former happened to the hydrochloric acid, with the result that for miles round vegetation was blighted and destroyed. The solid sulphide of calcium, or "alkali waste," was thrown out and formed ever growing and multiplying hillocks, hideous in aspect, and yielding, when soaked with rain, exhalations most offensive to the nose and drainings poisonous to neighbouring streams.

At last, about 40 years ago, the hydrochloric acid, which had gone to worse than waste, began to be utilized for the manufacture of bleaching powder. By ingenious and interesting processes, which within the last 20 years have been greatly improved upon, the hydrogen was banished from the hydrochloric acid, and the pungent green gas, chlorine, obtained, and delivered into large chambers partly filled with slaked lime. The doors of the chambers being kept closely fastened for several hours, the lime absorbs the chlorine —becomes, indeed, for practical purposes, so much conveniently portable chlorine, with all the peculiar power of that gas for the destruction of organic colouring matters. This utilization of hydrochloric acid for a commercial purpose of essential service to the owners

of bleach-works, dye-works, calico-printing works, and other industrial establishments, was both highly profitable to the alkali manufacturers and advantageous to the neighbourhoods of their works, which were at once relieved of a large part of one of the most noxious of the vapours which had escaped from them.

Within another 12 or 15 years an event had happened which essentially altered the outlook of the Leblanc soda industry. The ammonia-soda process had been established on a commercial footing in this and other countries. It had long been known as a fact of the laboratory that if " bicarbonate of ammonia " is added to a strong mixture of salt and water, what is known in chemistry as a double decomposition occurs, the carbonic acid gas (carbon and oxygen) leaving the ammonia to unite with the sodium in the salt and forming " bicarbonate of soda," which is precipitated, in a relatively insoluble form, and the ammonia and chlorine, united as " ammonium chloride," remaining in solution. This was obviously a much shorter road to the manufacture of soda from salt than that found by Leblanc. But it was not, in the first instance, by any means a cheap or easy road. On the contrary, the difficulties, mainly, I believe, of an engineering character, encountered in setting up the process on a commercial basis were so great that one experiment after another abandoned it. The cost alone of the ammonia used was so high, and its amount so large, that until means of reducing the expense so incurred to a *minimum* were devised the process could not be made financially successful. At last, in 1863, the eminent Belgian inventor, M. Ernest Solvay, started his ammonia-soda establishment at Couillet, near Brussels, and somewhat later Messrs. Brunner, Mond, and Co. began their great works at Northwich. Only step by step, however, even then, and only by the exercise of indomitable courage and perseverance on the part of the pioneers of the new process was economic success assured. The choice of site for Messrs. Brunner, Mond's establishment was determined mainly by reference to the presence of the great Cheshire salt beds, from which brine could be pumped in an unlimited quantity for an indefinite period. Other very favouring circumstances were the excellent system of water carriage to and from Liverpool, by the river Weaver, and ready accessibility to the Lancashire and Midland coal-fields, and to the limestone of Derbyshire. Chemically, as has been indicated, the ammonia-soda process is much simpler than that which goes by the name of Leblanc, but from a mechanical point of view the former is far more complex. Alike from that point of view, and in the scale of its operations, the ammonia-soda manufacture, as carried on at Northwich, is a great and even a grand industry. Symmetry and order have ever been the notes of that establishment. Essentially it is a series of pumping operations. The brine is pumped from the brine-pits. Ammonia produced by coke ovens on the premises is pumped into tanks containing the brine. Thence the ammoniated brine is pumped to the top of the " Solvay towers "—erections as high as a five-storey house—where it stands up to about four-fifths of the height of the towers. Into the base of these lofty columns of ammoniated brine carbonic acid gas from limekilns, also on the premises, is pumped with force sufficient to make it rise to the top, thus impregnating the whole. A long row of these Solvay towers is the central feature of the works. On one side of it stand in serried array the powerful engines required for the series of pumping operations just referred to. On the other side lie the settling tanks and furnaces for dealing with the products of the chemical operations in the towers. These products flow from each tower into a tank furnished with a strainer, through which the solution of ammonium chloride drops, and leaves the bicarbonate of soda as a powder at the top. This is washed by means of a revolving sprinkler to remove any adhering particles of salt. When clear enough of such adhesions, and dry, the bicarbonate of soda is shovelled off the tanks and descends into a small furnace, where, by the action of heat alone, applied evenly by ingenious mechanical arrangements, sometimes oscillating, sometimes revolving, to every particle of the powder, it is transformed from bicarbonate into simple carbonate of sodium, which is the thing required. Even by this bare outline it will, I hope, be realized in some measure how elaborate are the mechanical aids afforded to relatively simple chemical operations under the ammonia-soda process. The great feature of the conduct of that process by Messrs. Brunner, Mond has been the constant

and successful effort to improve the complex plant required at all points, and to develop appliances for the saving of labour. Besides their original establishment at Northwich, the firm has also works at Sandbach, at Middlewick, in London, and at Middlesbrough.

Carried on under such auspices, the ammonia-soda process yields, and has long yielded, the principal article required at a saving of cost so considerable as compared with the Leblanc process that if the manufacturing exponents of the latter had been confined to the production of soda they would before now have been driven from the field. It is the utilization of their bye-product, hydrochloric acid, for the manufacture of chlorine products, including not only bleaching powder, but chlorate of potash (used for making matches and percussion caps) and chlorate of soda, which has been their mainstay—so much so that it is, commercially, quite true to say that in the Leblanc soda industry at the present time soda is a bye-product of the manufacture of chlorine products.

The utilization of other bye-products of the original process has been of great service to the Leblanc manufacturer in his fight with the ammonia-soda process. This is notably so, for example, with the " recovery " of the copper from the cinders of the pyrites (burned, as will be remembered, for the manufacture of sulphuric acid) by what is known as the " wet-extraction process "—a branch of manufacture which has been in operation many years—and with the much more recent " recovery " of the sulphur from the " sulphide of calcium," or " alkali waste," at the other end of the Leblanc series.

The main features of this most interesting process, devised by Mr. Chance, of Birmingham, are the mixing of the solid " waste " with water into a kind of sludge, and the charging of this material, in a succession of vessels, with carbonic acid gas drawn with other gases from limekilns. Here, again, as in the case of the sulphate of sodium, the sulphur yields place to the carbonic acid gas, and there result carbonate of calcium in a solid form (useful for cement) and sulphuretted hydrogen gas. The latter, together with the gases by which the carbonic acid gas had been accompanied from the limekilns, and a certain quantity of air, is pressed forward into an apparatus called a " Claus-kiln." A complicated and violent chemical action takes place, with the result that a high temperature is evolved and sulphur of almost absolute purity issues forth in a molten form. The pure sulphur thus obtained as an ultimate bye-product from soda-making is so valuable for several purposes, notably the manufacture of gunpowder and " sulphite pulp," the substance from which paper is now so largely made, that it is said to be supplanting in the market the native sulphur procured from Sicily.

Thus it will be seen that for more than half the time that has elapsed since the establishment of the ammonia-soda process in this country, the Leblanc process has been from the point of view of commercial chemistry developed to an almost perfect cycle. Every constituent, that is to say, of every substance employed at every stage, is, if not altogether, yet to a very large extent, used up, and used up saleably. Yet, even so, the economies of the rival process in the manufacture of soda itself, as secured by the scientific and energetic management of its principal exponents here, are such that its relative advance has been steady and decisive. Not a few of the houses engaged in the Leblanc process found their profits reduced so much that they dropped out of the business. Very much the larger number of those which continued the struggle drew together for its more effective conduct, and formed the great syndicate known as the United Alkali Company. This powerful body, which has been in existence for about eight years, took over almost all the chemical works on the Clyde, on the Tyne, and, most numerous of all, on the Mersey. On the banks of the two former rivers it has 3,500 persons in its employ, and in the Widnes and St. Helen's districts something like 6,000. There can be no doubt that the formation of the United Alkali Company secured for the Leblanc process the best possible chance of survival. It has done so by the general enforcement, throughout the numerous works taken over by the syndicate, of the standards of administration in regard to labour and of efficiency in regard to plant previously prevailing in the most profitably managed of them.

Outlay in wages, which was considered beyond what the industry could afford, has been curtailed, and important further reductions have been made in the wasteful escape of gases which, under pressure of the competition of the ammonia-soda process, have become of increasing commercial value. Yet there seems no doubt that for the production of soda the Leblanc process must steadily decline, as it has been doing during the last few years. Thus the amount of salt decomposed in this country by the Leblanc process declined from 434,298 tons in 1894 to 360,929 tons in 1896, while the amount decomposed by the ammonia-soda process rose from 361,603 tons in 1894 to 431,577 tons in 1896—the relative positions of the two processes in the two years being thus almost exactly reversed. In these circumstances it is not surprising that an undertaking managed with so much spirit and foresight as the United Alkali Company should have already established on a considerable scale works for carrying on the ammonia-soda process. Plant for that purpose is now in operation at both Widnes and Fleetwood, and I am informed that the United Alkali Company's yearly output of ammonia-soda now reaches the figure of from 60,000 to 70,000 tons.

Perhaps the question of greatest interest in the chemical trade now is whether the decline of the Leblanc soda process will be permanently limited by the fact already referred to—that that process evolves on a large scale and in an available manner the hydrochloric acid required for the manufacture of bleaching powder. In other words—Is there any likelihood that bleaching powder, and other chlorine products, will come to be produced more cheaply than as an offshoot from the Leblanc soda process? Until quite lately the chlorine in the salt decomposed by the ammonia-soda process was practically lost. The ammonia in that process has for many years been "recovered" from the ammonium chloride, which, as will be remembered, is the residual product of the Solvay towers after the bicarbonate of soda is secured. That "recovery" of the ammonia, which is used over and over again, is made by the aid of lime, and the ultimate residue is therefore calcium chloride. In a very interesting address delivered by Dr. Ludwig Mond as president of the Chemical Section of the British Association in 1896, a description was given of an extraordinarily ingenious process by which, with the aid of magnesia and potassium chloride, instead of with lime, both the ammonia is "recovered" as before and the chlorine is made available for use in the manufacture of bleaching powder. Elaborate though this process is, Dr. Mond said that it had fully attained his object of enabling the ammonia-soda process to compete, not only in the production of carbonate of soda, but also in that of bleaching powder, with the Leblanc process. At the same time, he added that he had hesitated to extend the new process as rapidly as he would otherwise have done because of the possibilities involved in the processes lately developed for the production of chlorine by electrolysis. At that time no electrolytic process for the production of chlorine was in commercial operation in this country, and it was, perhaps, not firmly established anywhere else. Now, however, the electrolyzing of brine or of potassium chloride, with the result that chlorine and caustic soda or caustic potash are understood to be immediately available, is carried on to such an extent in Germany that more than all the demand for bleaching powder in that country is met by electrolytic works. Indeed, a large quantity is already exported, some even into England. Further, within the last year or so an electrolytic works has been started at Weston Point, near Runcorn, on the Mersey, which is undoubtedly producing bleaching powder in substantial quantity, and which, in December, 1897, forced down the prices by about a pound a ton below what, without its intervention, would have been the current rates. Permission to see the Weston Point works was refused me—an experience almost solitary in the course of my inquiries in behalf of *The Times*—the firm saying that they were extending their plant, that their works were in disorder, that all other applications have been for the present refused, and that I should be welcome next summer. That being so, I cannot attempt any account of the electrolytic process there conducted. At St. Helens an electro-chemical works is in operation and, I am told, is producing bleaching powder, chlorate of soda, and caustic soda. There are also other electrolytic processes, such as the "Hargreaves-Bird" and

the " Rhodin " processes, the development of which in this country is believed to be a matter of the near future. Speculation as to their future is fascinating; but I do not feel able to say more than that, while they may produce the chemical results desired with singular directness, the question of their commercial success must depend upon the frequency with which essential parts of the plant have to be renewed, and that upon that point very few persons are as yet in a position to form a judgment. The same remark applies to an extremely interesting electrolytic process invented by Dr. Hoepfner, which I had the privilege of seeing at Messrs. Brunner, Mond's, where it has only recently been brought into operation. It is led up to by utilizing the calcium chloride—which has been mentioned as the present ultimate residue in the ammonia-soda process—for the production, with zinc oxide, of chloride of zinc in solution. The solution of zinc chloride is run into cells, through which an electric current is passed, with the result that the zinc is deposited in a chemically pure state on iron plates, from which it is subsequently removed and then melted and run into ingots, and the chlorine is drawn off to be utilized for the production of bleaching powder.

The future of the trade is full of interest, but few, even of the most learned, will venture to forecast it with any confidence. In the main, however, it is satisfactory to know that the course of its development, especially within the last few years, under the combined influence of the rivalry of different processes, of the steady pressure of the alkali-inspectors, and also of a keener sense of the responsibilities of capital, has been to make chemical manufacture less disfiguring to the neighbourhoods in which it is seated, and less disagreeable and more healthy for the workmen engaged in it than it used to be. The gases emitted from ammonia-soda works have never destroyed vegetation in the manner so notoriously evidenced in regard to Leblanc works by the desolate appearance of Widnes and its immediate surroundings. But happily the improvement in administration and in standard of plant used under the *regime* of the United Alkali Company has led to an observable diminution in the emission of noxious gases from the chimneys of works under their control—so much so, that the growing of grass, flowers, and trees has ceased to be a hopeless undertaking at Widnes. The same causes have led to an appreciable diminution in the liability of the workmen employed to inhale poisonous or irritating gases. Much of the work, indeed, is still attended by more or less unpleasant odours, and they combine with the heats connected with several of the operations to render the workman specially open to temptations to drink when he has the chance. The packing of bleaching powder, I am convinced, has in the past caused breakdown of health, and even premature death, in not a few cases of persons whose bronchial tubes, being naturally irritable, were brought into a condition of chronic inflammation by frequent whiffs of offensive and pungent chlorine gas. But the general effect of the medical opinions I have obtained is to support the view that, with vigilant care, which, of course, is most essential on the part of the management, and also of the men themselves, bleach-packers, if they have no constitutional delicacy and if they live temperately, do not generally appear to suffer at all considerably in health from their occupation. With them, and with the workers in some other departments in Leblanc works, while carelessness and excess are specially apt to produce immediately or rapidly serious consequences, those faults are also rather specially liable to be induced by the conditions of work. These conditions, however, have improved, and, on the whole, the result of my inquiries is the opinion that a population very largely dependent, as at Widnes, upon Leblanc soda-works compares not unfavourably in health, morals, and manners with those of ordinary factory towns. The United Alkali Company, it is satisfactory to know, have given considerable attention to the subject of rescue appliances for cases where men are overtaken by accidental outbursts of noxious gases.

A serious drawback to employment in some departments of chemical works lies in the fact that it goes on, week in, week out, with no Saturday half-holiday, and with Sunday rest only obtained at the cost of excessive spells of work on alternate Sundays, when the shifts are changed. At the United Alkali Company's works this happens in the

case of about 22 per cent. of the men. The continuity of operations in the departments in question is doubtless essential; but it is equally beyond doubt that the absence of the ordinary Sunday rest is a great disadvantage to the men, both religiously and socially, and when the regular working day lasts for half the 24 hours that disadvantage is materially enhanced. It is right to state that at the works of the United Alkali Company the eight-hour shift has, for some years, been in operation at the "salt cake" furnaces, with benefit both to the men engaged in that arduous work, and to the company. The bleach-packers always work specially short hours. At Messrs. Brunner, Mond's, while there is a good deal of Sunday work, the eight-hour day prevails throughout all departments. I am assured that its results are economically satisfactory in the case of the process-men. The improvement which the shorter hours have secured in their health and spirits has been accompanied by a corresponding and, to their employers, advantageous development in their zest for and attention to their work. Among the labourers, it is true, the eight-hour day has not killed shirking and dawdling, but the indications appear, on the whole, promising. Labourers, as well as process-men, have improved much in respect of the punctuality and regularity of their attendance, and the standard now reached throughout the works in that respect is very high. This is shown by the fact that in 1897 90 per cent. of the labourers and 97 per cent. of the process men at the Northwich establishment enjoyed the privilege of a week's holiday with a week's (or, to be quite accurate, six days') pay, which Messrs. Brunner, Mond give each year to those of their men who in the preceding year have lost only four days' work without satisfactory explanation. As to wages, as might be expected, the process-men under the United Alkali Company at Widnes appear to run rather higher than at Northwich, 4s. 6d. to 5s. 6d. a day being a fairly common wage with them, while at Messrs. Brunner, Mond's the majority of the process-men earn only 3s. 9d., though the more responsible and skilful ones are rated up to 5s. or 5s. 6d. On the other hand, the labourers at Widnes, who are much more numerous actually and proportionately than at Northwich, earn only from 17s. to 18s., while at the latter works they receive 20s. a week.

XV.

EDUCATION AND INDUSTRY

WITHIN the last 15 years there has been a certain awakening of the public mind in this country to the fact that the education received by the classes engaged in the principal national industries is apt to exercise a considerable influence upon the success with which those industries are prosecuted. Five and twenty years ago the truth in question can hardly be said to have obtained any public recognition. In the full tide of the prosperity which was enjoyed by British manufacturers and commerce in the few years immediately following the Franco-German war, the idea of dethroning King Rule-of-Thumb naturally occurred to but few of a race so unimaginative as ourselves. Employers, guiltless of any acquaintance with the sciences bearing on the manufactures in which they were engaged, were piling up fortunes in every direction. A generation of working men, who had grown up for the most part with barely a knowledge of the three R's, were drawing wages such as had never before been enjoyed by labour since the beginning of the world. What more could be wished by a practical nation, or what better proof wanted that the English people, with the aid of certain natural advantages, such as cheap coal and iron and a favourable position for the conduct of maritime trade, were destined to keep the workshop of the world? From the purely material point of view, even the system of primary schools set up in 1870 seemed a work of supererogation, and Mr. Matthew Arnold's repeated protests against the absence of any system or definite aim in our secondary education were delivered in the wilderness.

There has been a great change since then. As you move about in the manufacturing districts of the North the evidences that the problem of education is being considered, from the point of view of its bearing on the conduct of industrial occupations, present themselves frequently and impressively. Colleges of University rank have risen in many important centres, giving to their students admirable opportunities both for obtaining a truly liberal education and for studying science in its most advanced applications, actual and possible, to the leading manufactures of the districts concerned. These institutions owe their existence to the liberality and public spirit of local citizens and, in the case of some important technological departments, to the enlightened munificence of the old London companies. Within the last half-dozen years, however, the resources of these colleges have been in part supplemented by a State grant, and by subsidies given by local authorities out of the "whisky money."

From the last-mentioned source also aid has been secured, I believe, in many cases, for schools scattered about over the industrial districts at which instruction is given in science of a less advanced kind than that imparted at the University colleges, together with courses of theroetical and practical preparation for work in special kinds of manufacture. The most impressive example of municipal liberality in this sphere is that of the Manchester Municipal Technical School—a building of vast size and stately proportions, reared at the cost of £130,000, and to be completely equipped, when finished, with a view to the illustration of courses of instruction designed "to enable youths, not less than 15 years of age, whose education is sufficiently advanced . . . . . to acquire a sound elementary knowledge, in theory and in practice, of the principles and processes" connected with mechanical, electrical, and sanitary engineering, and with the building, the chemical (including bleaching, dyeing, finishing, and printing), and the textile industries. This great institution will open with no fewer than 4,000 students, who are at present receiving instruction in several schools in different parts of Manchester, either in day or evening classes. The new Municipal Technical School, it need hardly be said, will provide courses

both in the daytime for those who are able to give all their time to education and in the evenings for those who are occupied at mills or workshops, but who wish to obtain something more than the merely partial and, in the narrowest sense, practical knowledge of their occupation, which is too often all that they either cared or were encouraged to learn as apprentices. In fact, it is the aim, as I understand it, of an institution like the new Municipal Technical School at Manchester, not indeed to impart either the discipline of character, or the manual skill, or the readiness of action in emergencies, which can be acquired only under the conditions of the workshop, but to supply that intelligent comprehension of the true character of the operations performed and of the natural laws they obey which is calculated both to stimulate interest in his work, whether on the part of the foreman or of the workman, to widen the range of his resources for dealing with difficulties, and to develop his aptitude for discerning the directions in which improvement is possible.

The textile industries, and especially the industry of weaving, present a field in which such school training as that of which I have been speaking is now widely recognized as being of high commercial value. The way was led there by the happy co-operation of the Clothworkers' Company of London and a number of enterprising Yorkshire manufacturers, in establishing the Textile Industries Department of the Yorkshire College at Leeds. In this connexion training in art plays a part not less important than training in science. Nearly the first, if not the first, requisite of success in the textile manufacturers is the constant production of novelties in design and in combinations of colours. To secure the provision of that requisite it is essential that the principles of design should be carefully studied and understood, not only in themselves, but in connexion with the possibilities and, so to say, aptitudes of the materials employed. It will be easily seen that for the acquirement of such knowledge there is a vital advantage in the systematic quality which distinguishes school or college training from that which under the most favourable conditions is obtainable during the course of apprenticeship.

Happily, very few years passed after the establishment of the textile industries branch of the Yorkshire College before the occurrence of events which verified in the most decisive manner the proposition which I have just stated. As has been mentioned in a former article, the stimulus given through the teaching of the textile department of the Yorkshire College, as well as of the considerable and useful technical school at Huddersfield itself, to the production of cloth possessing at once the best quality and the most attractive appearance, is recognized as having contributed in a sensible measure to the commanding position which Huddersfield has for some time held in the markets for high-class cloth for gentlemen's wear. Another interesting illustration of the same truth is furnished by the fact that the manufacturers of Leeds have been able to follow and perhaps even to quicken the change in taste which has led to the substitution of the manufacture of "fancy" goods made of woollen, worsted, and mixed materials for the plain cloths which used to be the main staple of the district. The increased elasticity and adaptability observable of late years in the trade of Bradford are regarded by the best local authorities as having been largely promoted by the presence of the Bradford Technical School. Probably in all these cases the most powerfully operative influence has been the scientific and artistic training received by persons who were preparing themselves definitely for positions of authority in cloth mills—managers, designers, foremen, and the like. But it should be clearly understood that the textile industries department even of the Yorkshire College includes among its students persons distinctly of the artisan class, and that the teaching given them is often very satisfactory in its results. Those who obtain it either have to do so by attending evening classes for a long period, or by giving up their work and wages in order to attend one or more years' courses of day classes. The sacrifice involved in such cases is very serious—indeed, I am told that there have been instances where it has amounted to not less than £90 or £100. Working men so keen to improve themselves ought not to have to undergo such sacrifices, and it is very desirable that some system of scholarships should be provided by which workmen who could clearly profit

by them might be enabled to attend the full day courses of lectures without pecuniary loss. Such a system would naturally be so arranged as to secure that the most energetic and promising of the students of the numerous technicals schools now in active operation in the smaller textile centres should be enabled to carry their studies further, in Yorkshire at the Yorkshire College and in Lancashire at the Manchester Technical School. For the selection of the students most worthy to receive such aid, opportunities could doubtless be afforded by the examinations of the City and Guilds of London Institute, which I believe from time to time inspects the local schools in question. The result could hardly fail to be a steady infusion, among the factory workers of the textile districts, of influences making for the elevation and enrichment of the standard of work.

The point which I have endeavoured to make in regard to the provision of means to aid enterprising artisan students to obtain the best training in the theory and practice of their occupation is of great importance and demands immediate attention. There would be less urgency in it than there is if it were not for the fact that the frequent postponement until adult or almost adult life of the development of intellectual interest in work is natural under our present system. I mean the system under which primary education is allowed to stop altogether, and full industrial occupation to begin at an age so early that the inrush of new impressions is almost certain to sweep away a large part of those which school teachers have laboriously sought to produce. There is something appalling in the waste of educational results which regularly and inevitably ensues in this state of things. In very many cases the breach in the continuity of intellectual development thus caused can never be repaired. It works ill in every direction. It limits deplorably the recreative interests of after life. Not less certainly it operates very injuriously upon the mind as an industrial instrument.

This brings us to a point where a painful admission must be made. It was the success of educational progress in Germany in promoting industrial progress which roused the public mind in England to a sense of the importance of the subject. But the teaching of Germany's experience was very imperfectly apprehended here. It seemed to be thought, and, indeed, it still is doubtless widely thought, that the Germans some 20 years ago lighted upon some mysterious kind of recipe for manufacturing success, which it is convenient to call technical instruction, and which mainly consists in a certain blend of scientific with mechanical training for the conduct of manufacturers. There has been, accordingly, a tolerably widespread development here of readiness to promote the provision of facilities for training of that character, and to make use of such facilities when provided. Great good has been done, and is being done, thereby in connexion with the textile industries, of which I have just spoken, and also in connexion with such trades as engineering and shipbuilding. This, however, is in great measure due to the fact that to a large extent the founders or managers of the most important seats of instruction in applied science wisely appointed as professors men who had the true scientific spirit, who were chiefly concerned to impart a sound knowledge of principles, and who were quite averse from any limitation of the scope of their teaching by so-called utilitarian considerations. But it is those considerations almost exclusively which have weighed, and continue to weigh, with a very large part of the parents of England, both in the employing and in the artisan class. That is the main difference between England and Germany in the matter of education. The English parent is apt to look upon his sons as essentially salary-earning or wage-earning machines, as the case may be. His great anxiety is that they should begin the discharge of that function as early as may be, and he looks upon every year that is spent without the receipt of earnings after they might be obtained as in a very real sense a year lost. The German or Swiss parent, on the other hand, recognizes that to make any success in life worthy of the name really possible to his sons, their minds must be not merely informed with knowledge which may prove of direct commercial use, but trained in habits of observation and consecutive thought, and endowed with width of view. Consequently he looks upon every year which in their case can possibly be spared from the engrossing burden of daily bread-work as a year gained.

The results of this difference of attitude are seen all round. In the case of the artisans it means that, except in the case of those who attend the non-compulsory evening continuation classes, the boy's mental training is sacrificed to the object of his bringing in wages two or three years earlier than he would do among our rivals. I am aware that for this practice there is advanced, especially in the cotton districts, the excuse that very early training in the mill gives a manual dexterity hardly otherwise obtainable. To me, however, the reply seems sufficient, first, that, even if it be so—and I do not think that textile authorities are by any means agreed on the point—the gain is bought too dearly; and, secondly, that the possibilities of kindergarten teaching, in cultivating the faculty for nice adjustments of hand and eye, have been by no means fully developed. In the case of the employing class, the parental temper of which I am speaking results in the boy's too often going to a college to learn scientific theory at an age too early in itself and with a mind quite inadequately prepared. The latter fault is due partly to the father's having failed to consider the importance of sending him previously to a school at which a broad and liberal foundation would be laid for a scientific superstructure, partly to the difficulty of finding such schools. It is absolutely vital to the national welfare, from this as from so many other points of view, that the problem of organizing secondary education should be grappled with by Parliament. Until that has been done the provincial University colleges, themselves for the most part excellent, will have no fair chance of rendering the State the full service they might render. They can only deal with the material brought to them, and it is not what it ought to be. In Germany it is common for those who are destined for posts of importance—managers and chemists—in large works to remain at a gymnasium, obtaining a first-class liberal education, up to 19, and only then to specialize on science. And when they do so specialize, as I am informed, they do it very distinctly from the liberal rather than from the technical point of view. One of the results is that there is a regular influx year by year into commercial Germany of highly-trained, first-class chemists, equipped in all essentials for grappling with the chemical problems of the great manufacturing industries, whether in steel-works, dye-works, tanneries, or what not. For such men there is a steady demand in the mills and workshops of the Fatherland; for their value is understood there. These things have long been so. That is the reason why, for example, it is the Germans and not we who have developed the manufacture of coal-tar dyes, and why in other branches of industry, the progress of which depends upon the combination of scientific research with inventiveness, German rivalry is becoming so dangerous.

Even now, after all that has been said and written about the importance of science to industry by statesmen and others whose practical character is beyond dispute, there lurks in the hearts of very many British manufacturers a view of the subject which, because it is essentially unscientific, is also essentially unfavourable to manufacturing progress. Far too many of them consider that to have a fairly-paid man about their works who does not periodically make an obvious contribution to the profitable character of the undertaking is bad business. The truth, which the Germans see, is that, supposing always that you have been well advised in the choice of your scientific man, his only real chance of doing justice to you and to himself is to give him all he wants in the way of a laboratory, and a perfectly free hand. He may very soon be able to suggest important economies in working. He may need to watch existing methods for a long time in the light of his own scientific knowledge before he is in a position to make any considerable suggestion by way of economy or other improvement in processes. But what is certain is that any insistence upon immediate commercial results must be paralyzing, and that discontent with the absence or slow appearance of such results is a feeling to be struggled against, not merely because it is illiberal, but because it is calculated to damage the commercial value of the instrument concerned.

Again, while in the engineering trades a large number of leading employers at various centres have given liberal support to engineering departments in local colleges, I am at present only aware of one such institution—the Durham College of Science at Newcastle—

attendance at which is treated as combining with time served in the workshops towards the completion of apprenticeship. In connexion with engineering I gather that the majority of those qualified to judge hold that the best professional results are secured by a certain amount of alternation of practical with theoretical training. It would be well that more facilities should be given for such alternation by arrangements on the part of the engineering employers with the colleges concerned.

Those colleges, again, ought unquestionably to be much more liberally treated by the State than they now are. It is almost humiliating to contrast the pittances doled out to them, with the hundreds of thousands of pounds spent out of public resources on similar institutions abroad. There is no fair chance of the development of scientific research with us in the fashion which is proving so advantageous to industry in Germany, unless it is either directly endowed, or, which might in some respects be more satisfactory, indirectly facilitated by such an enlargement, through State aid, of the scientific staffs of leading colleges as would allow their members reasonable leisure from teaching for the advancement of knowledge in their respective departments. But some direct endowment is also clearly necessary if we are to keep abreast of Germany. In a recent article of the present series attention was called to the very important manufacturing possibilities connected with electro-chemistry, some of which are already realized on a large scale in Germany. In that country the State keeps opening electro-chemical laboratories, with separate professors. In this country there is not as yet a single professor of physical chemistry.

Enough, perhaps, has been said to indicate the directions in which, in the interest of industrial success, not less than of culture, reform is needed in our educational ideals. At the same time, there has been evident, I hope, in the above remarks a recognition of the truth that the subject of technical instruction is one in regard to which sweeping generalizations are undesirable. Thus, special school courses may, from a commercial point of view, be of considerable value to the actual craftsmen in one industry and of much more questionable value in another. Again, there are differences between one industry and another in respect of the combination or dissociation of theoretical and practical training which constitutes the best special preparation for posts of importance in the conduct of works. But while on points of this kind there is room for debate, there is really none on the broad issue involved; and that is that, in all the ranks of life concerned, general education ought to be more thorough and ought to last longer than is now the case, and that the greatest material rewards will ultimately fall to that nation, and within it to those manufacturers and those families, by whom education is treated from the most broadly liberal point of view.

XVI.

CONCLUDING OBSERVATIONS

IN bringing to a conclusion these studies of the great industries of the north of England which it has been my office to place before the readers of *The Times*, it seems natural that I should, within a brief compass, draw together a few of the points which, during my inquiries, have most strongly impressed themselves on my mind. And, in the first place, I should say that, on the whole, these industries are maintaining a great population in a degree of physical comfort and well-being that compares very favourably indeed with the state of things that prevailed a generation ago. As to this fact, no doubt is entertained by those whose memory carries them back to the early sixties. The character of the average working man's house has changed greatly for the better. The accommodation is larger, and the rooms are very much better furnished than used to be the case. To say that there is much taste displayed in the choice of the furniture or ornaments of the artisan's home would indeed be going too far. But it it only within the last 30 years that in those respects the standards of classes much above him in the social scale have been redeemed from barbarism of the worst type. The parlour of the engineer, the ironworker, the boilermaker, or the textile worker is in a great number of cases eminently respectable, containing many pieces of furniture of very much the same general character as would be found in the best room of a fairly well-to-do shopkeeper's or clerk's dwelling, including very often a pianoforte or harmonium ; and when it fails to possess the air of perfect comfort, commonly does so only by reason of the fact that except in honour of a visitor, and on full-dress occasions, the family prefer to occupy the kitchen. In the vicinity of several of the largest manufacturing towns pleasant residential suburbs, away from the smoke and noise of the neighbourhood of the workshops, are very largely inhabited by artisans, who reach their work and return from it by cheap trains, tramcars, or omnibuses. No doubt the rents of these abodes are appreciably higher than what their occupants or their fathers used to pay, but they are well worth the difference, and the family incomes of the artisans who inhabit them are quite well able to meet that difference, to pay for comfortable and respectable clothing for father, mother, and children, to keep a table supplied with all the necessities of healthy nourishment and something more, and, very commonly, to provide for an annual holiday of several days at the seaside. It is by no means only the most highly skilled workmen whose domestic circumstances are or may be of this favourable description. There are, no doubt, at all the chief centres of manufacturing industry many hundreds, and at many of the smaller centres several scores, of first-rate artisans whose wages run from 40s. to 50s. a week or even more, and who would be able, by living carefully, and especially if blessed with an economical wife, to keep themselves and a family of moderate size in abundant comfort, besides putting by something against a rainy day. But the excellent homes and general material well-being of which I have spoken are far from being confined to the households of first-rate artisans with families of moderate size. They are enjoyed by very large numbers of families, the heads of which are no more than good ordinary skilled workmen earning from 38s. down to 30s., and often not even so much as the lower figure.

This is not merely due to the cheapness of food and clothing and, as compared with London, of fuel and house rent. Reasonably husbanded, a good ordinary artisan's wage in the north of England, if he have fairly regular employment, allows the maintenance of a standard of living greatly superior to that which prevailed in the middle of the century among the same class in any part of the country. But another most material consideration has to be borne in mind. The variety of occupations and the large amount of employment for women and girls over very large parts of the industrial districts of the north make it possible in a considerable proportion of working-class households for the collective income to amount to double and often much more than double that earned by the head of the family. Indeed, it may almost be said that from the time when the eldest son or daughter reaches the age of 15 until the youngest is married, or for other reasons leaves the family

roof, the average artisan's household has something of the nature of a little industrial company. By 15, for example, the eldest, if a girl, may be earning 10s. a week in a weaving shed. Three years later her earnings may have risen to from 14s. to 17s., while a brother may then be getting 7s. to 8s. as a junior piecer or spinner's assistant. In two years more, while the eldest daughter's wage may remain the same, the eldest son's will have risen, very possibly, to 16s. or 18s., and another boy or girl may be bringing in another 8s. or 10s. Thus by the time the eldest child is 20 the weekly income of the family, if the father is an engineer at 33s. or 34s. or more a week, or an ironfounder at 37s. or 38s., may easily amount to between 70s. and 80s. In the same way it may and not seldom, I believe, does grow, rather later, to £5 a week. Oftener, however, perhaps, the marriage of the elder children prevents the attainment of quite so large a collective total as that, and, of course, as first one and then another goes off to a separate home, there is a sharp decline in the family revenue. Still there can, I think, be no doubt that in a substantial proportion of working-class households in the northern counties, for periods varying from six to 15 years, the weekly earnings in good times range between 50s. and 90s.

The length of the prosperous period varies inversely with the propensity of the sons and daughters to marry and settle on their own account, and directly (*malgré* Malthus and the older economists) with their numbers. Its early beginning is, I fear, too often due to the practice referred to in the preceding article of sending children to work as soon as the law allows. In each family there is, unless the husband and father is a workman commanding high wages, a time—the first 15 years after marriage—during which, unless the wife and mother works much more than is desirable, great care is necessary in the control of expenditure, and of course such care must be felt to be the more difficult and irksome by those who have grown up amid the comparatively easy circumstances of such families as those of whom I have been speaking. Nor can it be deemed surprising that parents who remember having begun their own working life when mere children should have difficulty in recognizing the cogency of the arguments by which, with a very greatly preponderant voice, those who are interested in questions of education urge that the children of the working classes should be kept at school much longer than they are, and deprecate with something like vehemence the continuance, under existing conditions, of the half-time system, which, though much less operative than it was, still prevails to a considerable extent in Lancashire and some parts of the West Riding.

In whatever way the question of the suitable age for sending children to work may be determined—my own sympathies are cordially with those who would make that age as late as possible—the fact will remain that after two or three of the children of a family have passed it the income of very many artisans' households in the larger part of the industrial districts of Yorkshire and Lancashire will become, and for several years will continue, sufficient to make their circumstances very comfortable indeed. This is an economic fact of no small importance. It facilitates saving by the parents for their declining years. Thus I am told that many spinners (of whom a good proportion earn from 40s. to 50s. a week) have £200 to £300 put by in savings banks, or invested. The number of artisans in various trades who are proprietors of their homes is very considerable. Again, the same state of things must make saving fairly easy, as it is so very desirable, for many of the young people, in contemplation of the early years of married life. I do not say that there is no other side, even economically, to the benefits of the system of which I am speaking. The fact that collective family incomes are often so considerable very possibly operates in many cases to make the individual members of such families content with lower wages than they are really worth, with the result that solitary workers with whom they compete, especially women and girls, whose labour is very largely unorganized, are worse off than they need be. I imagine that this influence may have something to do with the low wages received by many of the female workers in the ready-made tailoring and boot and shoe trades. Still the advantages enjoyed by very many working-class households in the extensive districts in which a variety of employment is obtainable are very substantial.

Of course, times of bad trade not seldom arrive, and then the family income declines; but then also there is seen one of the chief merits of the system to which I am drawing

attention. While one or two members of a family may be out of work or poorly employed, others may be receiving good wages; for it often happens that while engineering or boiler-making is depressed, textiles or ready-made tailoring or the boot and shoe trade may be doing fairly well. Even when one weaving mill is running slack, another in the same neighbourhood which caters for a rather different market may have some good orders in hand; and it is, I think, a common thing for the girls of a family to recognize this fact, and to act upon it by working for different employers in the same trade when there is not a choice of trades available.

This brings me to an aspect of my subject which has an important bearing on the feelings of satisfaction with which one cannot fail to contemplate in themselves the high degree of material comfort often secured and the protection against the shock of trade depression also afforded by the system of what I have called family industrial companies. That system, as has been seen, depends very largely on the employment obtainable by girls and women in factories of various kinds, and particularly in cotton and woollen cloth weaving, ready-made tailoring, and also wholesale boot and shoe making. What is the general effect on the female character of the factory system, which, be it remembered, has only displaced the old spinning-wheel and hand-loom industry in some parts of the West Riding within the memory of men still in middle life? In Lancashire the change was general, I think, a good deal earlier, but I have heard from an eminent cotton spinner and manufacturer, now living and working in a hale and vigorous old age, the story, full of far away interest, of how, when a young man, he used to drive once a week from Manchester to different places in the country where his firm had houses, at which he received and paid for the cloth which had been woven in the weavers' houses up and down the country side, and gave them warp on which to work for the next week. With the money thus earned the rent of their little farms was paid, and the occupation was probably a welcome variation amid their regular agricultural pursuits. There was a great deal to be said in theory for that combination of occupations, and in practice it doubtless produced many fine types of character. It was also sometimes associated with a good deal of culture. A large employer in a manufacturing village near Leeds, in which 30 or 40 years ago almost every house was a little manufactory, remembers that some of these peasant-weavers used to read Latin authors in their times of recreation. Thoughtful men they were, and political leaders among their neighbours, with strong views as to the measures needed to make England a good country to live in—views which, to a large extent, have since been embodied in Acts of Parliament passed under both Liberal and Conservative auspices. It was a great change from that mode of life to the large factory system, and by no means in all respects a change for the better, intellectually or morally. When one tries to form a conclusion as to the influence of factory life on women and girl weavers, for example, working in large numbers together, drawn from all kinds of homes, and under the supervision of male overlookers, one hears very different opinions from observers who are apparently very much alike in their opportunities of knowing the facts and their capacity of drawing fair conclusions from them. In places at no great distance from one another I have heard views on this subject very unfavourable, and, on the other hand, very generally favourable, from wives of parish clergymen deeply interested in the domestic life of the working-classes and closely in touch with it. Again, working-class parents careful of their children's characters have said to me that while to some mills in their own district they would send their daughters to work with an easy mind, there are others in the same district as to which they would consider that to do so would be courting moral disaster. On the whole the conclusion to which I am drawn is that which *a priori* would have seemed most probable—that the influence of mills on the lives of those women and girls who work in them varies mainly in accordance with the sense of responsibility possessed by the owner, and shown by him alike in the sanitary arrangements of the mills and the character of the overlookers and other persons whom he appoints to exercise authority, and in the indefinable thing called tone, which is affected for good or ill by what is known as to the master's wishes. In regard to the first of the points just indicated it is right to say that, as in many other ways, excellent service has been rendered, sometimes under circumstances of considerable

difficulty and delicacy, by the women factory inspectors who have been appointed of late years. Even if it has happened now and then that they have unduly magnified points not of essential importance, I am convinced that the general effect of their work has been, and is, to humanize and elevate the atmosphere of factory life. The actual results which they have been able to achieve in regard to the improvement of sanitary arrangements vary considerably with the amount of enforcement which their representations receive from the local authorities with whom, for reasons possibly intelligible to themselves, Governments and Parliaments have left the function of acting or not acting upon such representations. In some cases they have acted with remarkable vigour and effect. Elsewhere it is otherwise. I can see no reason whatever why, in all departments of their duties, the women inspectors should not be subject exclusively to the support or absence of support of the Home Office in the exercise of its discretion. I should like, however, to have the opportunity of subscribing to some observations in the interesting chapter on women's labour contained in Mr. Geoffrey Drage's book on the Labour Problem. He urges that it is most desirable that the ladies of the families of employers should recognize very much more widely than is at present the case that they have a responsibility, which they may neglect but cannot escape, in regard to the conditions under which their humbler sisters work in the factories from which their wealth is gained. It would, I think, be impossible to exaggerate the benefits, and those by no means all on one side, which would result from the more general exhibition, on the part of the wives, sisters, and daughters of manufacturers, of genuine human interest in the physical and moral welfare of the female workers in the mills on which their material property depends.

The maintenance of other than mere commercial ties between the employing and employed classes is indeed one of those questions as to which it is impossible to avoid feeling a certain amount of anxiety in the case of many industrial districts in the north. There are, no doubt, still many employers, especially in the case of the smaller towns and manufacturing villages, who live near their people and whose relations with them have not become impersonal. Even in the greater centres, too, I do not doubt that in many cases resolute and successful endeavours are made by masters to keep in touch with their workmen and to know them otherwise than as "hands." But as the towns draw nearer together "in a blacker, incessanter line," as railway communication with country districts becomes ever easier and more frequent, it is natural and almost inevitable that well-to-do families should more and more draw out of the smoke-cloud and clear of the disfigurements which even well-built and gardened suburbs will inflict upon the face of the country. Thus the physical barrier of distance and the moral barrier of totally different local associations and interests tend increasingly to keep apart those whose interests are in truth essentially bound up together. And this tendency is unfortunately much intensified by the multiplication of limited liability companies, with their delegation, partial even where not complete, of supervision which used to be personal and direct. Of hostility or unfriendly feeling between the employed and the employing classes I have found very few signs, nor do I see any reason to apprehend a development of such sentiments. But there does seem to me to be some ground to fear the growth, not of hostility, but of aloofness, between sections of our population who have everything to gain from intimate knowledge of and co-operation with one another. Effort and sacrifice are needed to avert the realization of this danger. And primarily they must come from the employing class. The sacrifices which I have in view are not at all mainly those of means, but of leisure, often hard earned, and of sports and amusements in themselves often altogether wholesome. But these sacrifices are worth the making, as will be most readily recognized by those of both sexes, and they are happily by no means insignificant in numbers, who make them already. Acting together in that confidence which results from frequent mutual intercourse, the employers and the artisans of the north of England may reasonably hope to solve their own economic problems and those, which of late years have seemed somewhat menacing, presented by the large masses of unskilled labour. Acting together they will see their way to the steady advancement of the standards of life, æsthetic and sanitary, in the greater and smaller centres of manufacturing industry. So will they prove worthy of one another and of England.

The Times, Wednesday, April 20th, 1898.

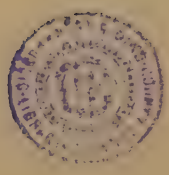
XVII.

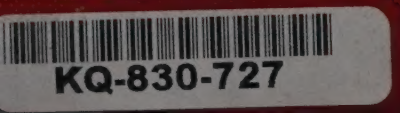
WE publish to-day the conclusion of the series of articles entitled "The Industrial North." We are much mistaken if our Correspondent's careful and dispassionate examination of the great industries of the North of England has not been instructive even to those best acquainted with the towns and districts which he has studied, and has not opened the eyes of manufacturers and producers to some new views of their duties and interests. He has been sparing in enunciating theories; he has been copious in narrating facts; and he may claim to have given for the first time a realistic account at first hand of our industrial centres—an account, too, not only of the processes of our great industries, but also of the lives, habits, and ways of the workpeople. The upshot of most of his observation is reassuring. Any one who made such a survey a quarter of a century ago or earlier could not truthfully be silent about traces of misery and discontent which he saw in the northern towns. He must have heard angry murmurs against all who were well-to-do and fierce threats by people who thought they must be wronged by a system under which they fared ill. He could not have missed seeing factories and workshops in which the letter of the Factory Acts might be observed, but in which there was scant attention to the health of the workpeople. He would have noted a certain hardness of relations between employers and employed, a tendency on the part of both to think their duties were confined to an observance of the letter of their contracts. Happily, matters are different now. From his journeys in Lancashire and Yorkshire our Correspondent brings back an encouraging and hopeful account. To take the vital question of houses. Most men are very much what their homes are, and the working man's house is, as a rule, much better than it was. On his table is better food, and more of it; fuel is abundant; and his rooms are very much better furnished than they used to be. Very often a piano or harmonium is to be found in the parlour, and provision is generally made for an annual holiday extending over several days to the seaside. Spinners earning 40s. to 50s. a week have a lot which many a clergyman or struggling doctor with "appearances to maintain" might envy. And even when the wage of the head of the house is much less than this the earnings of the whole household may secure to it plenty and comfort. Factory, Mining Regulation, and Education Acts have raised the age at which life begins for the mass of the children of the working classes. But by 15 boys and girls are bringing every Saturday no small sum to their homes. The result may be to double the collective income. Sometimes it reaches £5 a week; and "in a substantial proportion of working-class households in northern counties, for periods varying from six to fifteen years, the weekly earnings in good times range between 50s. and 90s." Of course, with these facts before their eyes even the most prudent of the young people marry early. Another effect of the facility with which boys and girls can earn wages is the temptation to send them to work as early as possible, and to grudge every month withdrawn from remunerative work. What is creditable and encouraging is that the heads of households with quivers full of children able to earn wages do not waste their substance in their prosperous years; that many of them purchase their houses; and that not a few have accumulated as much as £200 to £300 in savings banks. The doctrine that thrift is foolish and even wicked, which finds favour with some leaders of the working classes in the South, would be derided by the hard-headed men whom our Correspondent describes.

Another circumstance no less satisfactory is to be noted. The change from the days of the old spinning-wheel and hand loom was in some ways a change for the worse. Old domestic ideals were destroyed or impaired. The men lost something by being less their own masters and being withdrawn from their homes; the women lost still more by being unable to perform their household duties; and the children lost most of all. Even in

mills owned by humane owners there was apt to be a roughness, an absence of moral supervision, which made the mill no good school for the daughters of working men. Our Correspondent speaks highly of the influence of the women who have of late years been appointed factory inspectors. "The general effect of their work has been to humanize "and elevate the atmosphere of factory life." But, after all, Government inspectors paying a hurried visit at long intervals can do little as compared with the owner of the factory or mill. He in the long run determines for good or evil the moral tone of his overlookers and servants. We do not doubt that employers have in these days more at heart those indefinable, but all-important, duties which, according to our Correspondent, make for the factory system the difference between good and bad. But there are dangers ahead due to circumstances for which no one is to blame. Many millowners and manufacturers still live close to their works; but for obvious reasons they and their families tend to seek pleasanter surroundings. The joint-stock company is often the employer, and a board of directors, though liberal and well-meaning, must fail to create the personal tie which grows up between an individual employer and his workpeople. Our Correspondent brings back no tales of fierce antagonism on the part of the masses against the classes. There are no Nihilists in the industrial North and apparently few Socialists. The men whom he describes have no sympathy with anarchical economical schemes for nationalizing this or that. But he does fear the growth, not, indeed, of class hostility, but of aloofness between sections of our population who have everything to gain from intimate knowledge of, and co-operation with, one another. We have not solved—we are still a long way from solving—the moral and economic problem of uniting the industrial efficiency of the grim-looking factory with all the virtues of the system which it drove out.

Our correspondent's account of the condition and outlook of most of our industries is hopeful. But there is need of prudence in all concerned if this is to be maintained. To take one of the greatest industries, coal-mining, he is doubtful whether over a considerable portion of the northern mining districts any profits are being made; and he is inclined to think that the passing of a Mines (Eight Hours) Bill "would be likely to cause the "rapid close of the less fortunate class of pits, with the result, not only of much local loss "and distress, but of a sharp rise in coal prices, producing widespread industrial and general "inconvenience." More than once in his series of studies our Correspondent has called attention to an inaptitude on the part of many employers to take full advantage of scientific agencies, and a tendency to cling to old ways of doing business or manufacturing. For the instruction and warning of this class especially the "Industrial North" has been written. If our Correspondent be right, these laggards must bestir themselves, and that quickly, if they are not to be in the end squeezed out.

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